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THE UNITED STATES AND CUBA.

EVENTS which will possess considerable historical importance have been succeeding one another in the Cuban struggle with great rapidity during the past few days. It was inevitable that sooner or later the question of the relation of the United States toward the belligerents should assume an acute phase, and that from some quarter or other an explicit statement of our attitude should be demanded. The circumstance attending the birth of our republic and our claim to be the nation which before all others secures the liberty of the individual, and the equal sharing by all of both the burdens and blessings of its government, have naturally aroused in the United States the keenest interest in this struggle of the Cuban natives against a taxation which they claim brings with it no proportionate representation.

It is natural that this interest should be strongly sympathetic; and it is safe to say that the people of the United States would welcome the news that Spain had decided to grant to the Cubans at least that form of local self-government which they originally asked. But while the sentiment of this country is unmistakable, it must never be forgotten that there is a broader aspect of the question—that which judges it in the light of international usage and well established precedent. The kingdom of Spain, of which Cuba forms a part, is administered by a government with which our own is on friendly terms; and, however much we may sympathize with the political struggles of one section of her subjects, we are bound to fulfill to the letter the obligations which international law imposes. The laws of neutrality prohibit the fitting out in a friendly port of an expedition which is known to be designed for use against one of two belligerent powers. The Geneva Conference held that England had broken this law in the case of the Alabama, and fixed the damages at $15,000,000. It was in obedience to the obligations of this law that the Federal government recently seized the merchant steamship Bermuda, with its supplementary cargo of arms and ammunition destined for the use of the Cuban insurgents, and arrested some eighty of its Cuban passengers. This was a purely legal proceeding, barren of sentiment; it was in no sense an expression of sympathy with either of the contending parties.

Following close upon the detention of the Bermuda, and no doubt to a certain extent precipitated by that incident, has come the passage by large majorities in both Houses of certain concurrent resolutions, which are of such supreme importance that we print them in full:

"Resolved, By the House of Representatives (the Senate concurring), that in the opinion of Congress a state of public war exists in Cuba, the parties to which are entitled to belligerent rights, and the United States should observe a strict neutrality between the belligerents.

"Resolved, That Congress deplores the destruction of life and property caused by the war now waging in that island, and, believing that the only permanent solution of the contest, equally in the interest of Spain, the people of Cuba and other nations, would be in the establishment of a government by the choice of the people of Cuba, it is the sense of Congress that the government of the United States should use its good offices and friendly influence to that end.

"Resolved, That the United States has not intervened in struggles between any European governments and their colonies on this continent, but from the very close relations between the people of the United States and those of Cuba, in consequence of its proximity and the extent of the commerce between the two peoples, the present war is entailing such losses upon the people of the United States that Congress is of the opinion that the government of the United States should be prepared to protect the legitimate interests of our citizens by intervention if necessary."

These resolutions were passed under a suspension of the rules, and after a vigorous debate for which a limited time was allowed. At present they amount to an unmistakable expression of national sentiment and opinion; but until they receive the indorsement of the President they have no diplomatic standing. According to press reports, the President is opposed to any such expression of opinion, in which case it is safe to assume that the resolutions will stand as they are, and the diplomatic relations between the two countries will remain unbroken.

The publication of the resolutions in Spain caused a profound sensation, and riotous demonstrations were made against the United States consulate in the city of Barcelona.

These were followed by a prompt and full disavowal by the Spanish government of any responsibility for the disturbance, and at the present writing there is no danger of immediate diplomatic rupture.

The spirit which prompted the Senate and the House in this matter is unquestionably a true reflex of the spirit of the American people at large. Moreover, it is directly in keeping with the policy so ably advocated by Mr. Blaine, which had for its object the strengthening of the commercial ties between this country and the various South American races. The wording of the last clause of the resolution and the suggestion of intervention are, perhaps, liable to be construed as meaning more than the two Houses intended. It cannot be intended as a threat of war; for, as such, it would stand in direct contradiction to the opening statement that "the United States should observe a strict neutrality between the belligerents." The demand for belligerent rights and that the admin-

GUERRILLA WARFARE IN CUBA.

istration shall in a friendly way exert itself in the interests of Cuban independence will commend itself to the temper of the people of the United States, but the closing reference to "intervention," which would mean war, is unfortunate, for the reason that it is likely to injure the very cause which the resolutions are seeking to promote.

In this respect the wording of the resolutions has provoked a resentment abroad where no offense was intended, and the recent outburst of hostile demonstrations on the part of the Spanish populace shows how easily this may be done. On the other hand, the use of ill-considered language and the passage of hastily drawn resolutions serves to embitter the feelings of the parties and renders the peaceful settlement of the questions at issue more difficult. Spain would not be likely to offer home rule to Cuba if she felt that she was being coerced to that end, and the Cubans would not be likely to accept it if she imagined that the United States ships and men were ready to fight for her absolute independence.

The same disturbing effect was noticeable among the Venezuelans as the result of the message of December last; and it was so marked as to call for a warning from the President that they should refrain from all hostile demonstration.

Meanwhile the Cuban patriots are carrying on the war with a heroism and dauntless bravery which has not been dismayed by the return of the notorious Weyler. The press censorship has become so guarded that it is difficult to secure reliable news, but that which has come to hand indicates that the Cubans are maintaining their guerrilla warfare with continued success. Against regular troops this is the most effective method, and until the insurgents can secure ammunition and general war material it is their only alternative.

Our illustration, for which we are indebted to the Illustrated London News, shows a body of Spanish cavalry being taken by surprise by an ambush of Cuban riflemen.

THE SCIENCE OF SOCIAL STATISTICS.

THE fifth lecture in the special course by Carroll D. Wright before the School of Social Economics, 34 Union Square, New York, related to the statistics of manufactures, including capital invested, products, etc. At the opening of his lecture Mr. Wright presented the three subjoined tabulations, taken from the United States census for three separate years, showing the remarkable increase in industrial interests in forty years:

	1850	1870	1890
Number of establishments....	123,025	252,148	355,415
Amount of capital...........	$535,245,351	$2,118,208,769	$6,525,156,486
Males employed..............	731,137	1,615,598	3,745,123
Females employed..	225,922	323,770	846,614
Total employed..............	957,059	1,939,368	4,591,737
Children employed...........	——	114,628	120,885
Total wages paid..	$236,755,464	$775,584,343	$2,283,216,529
Value of material...........	$555,123,822	$2 488,427,242	$5,162,044,076
Value of products	$1,109,106,616	$4,232,335,442	$9,372,437,283

The lecturer stated that while the collection of all statistics was attended with obstacles which well nigh discouraged even the experienced statistician, the obstacles in the way of accurate economic statistics were equally as great. It is essential in order to ascertain the total manufacturing business of the country to obtain the facts for each establishment engaged in manufacture. Through this method the Federal census undertakes to collect the data relating to the number of persons employed, the total amount of wages paid, the aggregate value of all products, the capital invested, and some other essential features. The United States census takes up this branch of economic statistics; although it is not common in other nations. In 1810 the United States government undertook, at the time of the enumeration of that year, to collect information relating to the industries of the country so far as manufactures were concerned. Eventually, of course, this effort was extended to agriculture, so that now, and in several decennial censuses, the progress of the country, and various facts relating to production, have become important features of our enumeration. Notwithstanding the efforts and money expended by the government to secure the facts relative to industrial progress, there has resulted much confusion; and this confusion grows out of inherent difficulties. Much harm, it is true, has been done, as well as great good accomplished, by this large extension of census powers. Let the good be admitted; it is the duty now to bring out the harm that has been done, that we may be forearmed when using census statistics relating to production.

There is great hesitancy on the part of manufacturers in giving certain facts which are called for. Sometimes the proprietors will hesitate to give the total value of the product of an establishment, while being perfectly willing to give the total number of persons employed and the aggregate wages paid to them, and also the capital invested; others will hesitate about capital invested, and readily give all the rest; but usually, and until recently, they have objected most to giving the capital invested in their business. This hesitancy on their part, and a faulty schedule on the part of the census, have resulted in fallacious conclusions relative to the capital invested and the relation of capital to product.

No attempt was made by any census to secure the total capital invested until that of the State of Massachusetts in 1885; the census inquiry on this point before that year generally calling simply for "capital invested," without any discrimination as to whether it was capital paid in by the concern or whether it was borrowed or given to it. The manufacturer has always been expected to state simply the capital actually paid in and used in plant, of whatever nature, as working capital. That he has given nothing more has not been his fault, for he has not been asked for more. The unsatisfactory result of the old statistical method is easily illustrated. Let us suppose a case in which there are four separate establishments in some particular industry, each of which produces $1,000,000 worth of product in a single year; the total value of the products of the four establishments being therefore $4,000,000. The capital invested of establishment No. 1 is $1,000,000; this amount of money having been paid in by the proprietors, and being sufficient in all respects to cover plant of all kinds, tools, implements, and working capital, for the production of $1,000,000 worth of goods. Establishment No. 2 produces $1,000,000 worth also, but has only $300,000 actually invested. It borrows annually on the average $700,000, giving the establishment the use of $1,000,000 worth of capital. Establishment No. 3 actually owns $500,000 of capital, invested in proper ways, and borrows $500,000 more. Establishment No. 4 uses $200,000 of its own capital and borrows $800,000. Each of these establishments, as above stated, has produced $1,000,000 worth of goods during the census year. The result for the four is $2,000,000 of capital actually paid in and $2,000,000 of borrowed capital. In all census returns the $2,000,000 capital paid in would be returned as the whole amount of capital invested. The relation, consequently, stands: $2,000,000 of capital invested, producing $4,000,000 worth of product! And yet the actual fact is—and it is a fact which has never yet appeared in any Federal census—that $4,000,000 were necessary in capital for the production of the $4,000,000 worth of goods. It is perfectly apparent on this statement, which, as already remarked, is a truthful illustration, that all such calculations based upon the returns must be vicious in toto. The Federal census of 1890 undertook to correct the old evil, and did so to a certain extent, by securing the figures for the amount of interest paid for borrowed capital, and from this fact calculating the amount of borrowed capital itself.

There is another difficulty in the question of borrowed capital. For instance, a man goes into the business of manufacturing a certain line of goods with little or no capital—say $5,000—but he has an excellent credit. He purchases raw material and all his supplies on long time; three, four or six months, but at the same time, sells the product of his establishment for cash or its equivalent. In this condition of affairs he may produce say $200,000 worth of goods in a given year, having but $5,000 actually invested. In all census statistics this would be the only sum that would appear, while $200,000 would appear as the value of the product. The truth is that he has borrowed of his own customers sufficient capital to produce $200,000 worth of goods.

Mr. Wright claimed that borrowed capital should be returned, if it is essential to the product returned, in the census. For he claims that it does not matter where capital used in the production of goods comes from; or whether it be the result of long time purchase of material under other credits; so long as these elements of capital are essential to secure a given product, they constitute capital invested, and should be covered by any census inquiry into industrial conditions.

Another obstacle in the way of securing scientific results lies in the duplication of raw material. The census of 1890 returned the value of product at $9,372,437,283. Of this amount $5,162,044,076 represents the value of raw materials used in producing the previous amount of value. But this latter amount could be reduced almost indefinitely, for the reason that the raw material of one manufacturer is often the finished product of another, and a product which has been returned in full by the first. This difficulty is easily illustrated.

Suppose a manufacturer of sofas returns one sofa at $50. In the production of this sofa he has used $5 worth of hardware, $10 worth of covering, $6 worth of lumber and $3 worth of upholstering materials, or in all $24 worth of products, which have already been returned by other manufacturers as their finished product. So the census figures would give $74, using the product of the sofa manufacturer, and the product of the others who have contributed their finished products as raw materials to the sofa maker.

Thus there is a constant duplication and reduplication of the value of raw material. To eliminate these things is an impossibility; at least it is an impossibility to eliminate them to such an extent that an exact comparison can be made. It is well enough, therefore, to compare the total value of product at the different censuses.

Another difficulty in the way of securing thoroughly satisfactory statistics relative to manufactures lies in the ever varying number of persons employed. The aggregate wages paid in an establishment constitutes the most exact figure to be obtained. The books of a concern show at once the aggregate amount of money paid out in wages, but the books do not show, without an immense deal of analysis, the precise number of different individuals to which the aggregate sum of wages has been paid. So taking the aggregate wages paid and dividing that amount by the number of persons employed, for the purpose of securing an average wage, does not result in a scientific statement. In all probability the better way would be to ascertain the aggregate amount of wages paid to a certain number of positions which must be filled, without reference to the number of persons employed during a given time to fill these positions. This would be the surest economic method; but for social purposes the total number of persons paid from the aggregate sum is essential.

All these difficulties in census taking are being remedied by degrees, but the inherent difficulties are those which seem to baffle the perfect application of the statistical method.

The lecturer closed with some comparative tables of the United States with the leading European countries:

VALUE OF MANUFACTURES PER CAPITA.

Germany................................	$61 00
France	68 00
United Kingdom..............	110 00
United States...	150 00

TOTAL VALUE OF PRODUCTS.

United Kingdom, 1860...	2 885	millions.
" 1888........	4,100	"
United States, 1860	1,885	"
" " 1890..........	9,370	"

The figures for the United States are very significant, and there is every reason to expect that the steady and phenomenal growth of the past will be repeated in the future industrial life of the nation.

THE INDUSTRIAL REVOLUTION IN JAPAN.

By WILLIAM ELEROY CURTIS.

JAPAN is becoming less and less dependent upon foreign nations for the necessities and comforts of life, and is making her own goods with the greatest skill and ingenuity. Since their release from the exclusive policy of the feudal lords, the people have studied the methods of all civilized nations, and have adopted those of each which seem to them the most suitable for their own purposes and convenience. It is often said that the Japanese are not an original people; that they are only imitators; that they got their art from Korea, their industries from China, and that their civilization is simply a veneer acquired by imitating the methods of other countries. All of this is true in a measure, but it is not discreditable. The Japanese workman can make anything he has ever seen. His ingenuity is astonishing. Give him a piece of complicated mechanism—a watch or an electrical apparatus—and he will reproduce it exactly and set it running without instructions. He can imitate any process and copy any pattern or design more accurately and skillfully than any other race in the world. It is that faculty which has enabled Japan to make such rapid progress, and will place her soon among the great manufacturing nations of the world.

It was only forty years ago that the ports of Japan were forcibly opened to foreign commerce. It was only twenty-eight years ago that the first labor-saving machine was set up within the limits of that empire. Now the exports and imports exceed $115,000,000.

EXPORTS AND IMPORTS.

Year.	Exports.	Imports.
1885....	$18,573,346	$14,678,484
1894	56,623,043	58,740,978

Values stated in American gold on the basis of two silver yen to the dollar.

The industrial revolution that is now going on in Japan is quite as remarkable as the political revolution that occurred there thirty years ago, and equally important to the rest of the world. Until recently all the manufacturing done in Japan has been in the households, and 95 per cent. of the skilled labor is still occupied in the homes of the people and in a measure independent of the conditions that govern wage workers in other lands. The weaver has his loom in his own house, and his wife, sons, and daughters take their turns at it during the day. It has always been the custom for children to follow the trade of their parents. The finest brocades, the choicest silks, the most artistic porcelain, cloisonne, and lacquer work are done under the roofs of humble cottages, and the compensation has heretofore been governed usually by the quality of the piece produced.

Below is given the distribution of the exports of Japan among the several nations in the year 1894:

United States..........................	$21,661,779
France	9,749,388
Hong-Kong..............................	8,099,740
China..................................	4,406,994
Great Britain	2,975,099
British India.......	1,844,079
Germany	758,774

The remainder of the exports of Japan are sent in small amounts to nearly every nation in the world.

The following table shows the source of the imports of Japan:

Great Britain..............	$21,094,937
China........	8,755,753
United States	5,491,279
British India..........	5,280,224
Hong-Kong....	4,499,859
Germany..........	3,954,771
France..............	2,174,024

In olden times the feudal lord, or daimio, who ruled a particular province, was always expected to purchase the highest grades of industrial art that were produced in his jurisdiction; but now there are middlemen who stand between the artisans and the public markets and buy for both the local and the export trades.

These middlemen are the same who used to handle similar wares during the days of the daimios, and their fathers followed the same business before them. The relations between the producer and his agent have gone on for centuries in the same family. Asana, the weaver, sells his brocades to the great-grandson of the merchant who bought his great-grandfather's product. When a large order is to be placed, say for 1,000 lacquer trays or 10,000 embroidered shawls, the middleman distributes it among the families of his acquaintance who are in the habit of doing such work. If they are poor, he advances them money and furnishes them materials. He is usually their banker, and they keep an open account with him, being credited for whatever they furnish and charged with whatever money or supplies he gives them. If they get a little ahead, he advises them in making investments, and acts as a friend and counsel in financial affairs. The relations between these commission men and their clients, which sometimes extend over provinces as large as our States, have nothing to resemble them among the working classes of Europe or America.

The ancient system of household labor is being rapidly overturned by the introduction of modern methods and machinery. The older artisans are offering a vain resistance, and cannot be drawn from their antique looms and forges by any inducement that has yet been offered, but the younger generations are rapidly acquiring a knowledge of the use and value of labor-saving machinery, and factories are being built in all parts of the empire. The greatest progress thus far has been made in cotton spinning and weaving, but several iron mills have been established and machine shops are springing up all over the empire.

The first manufactory established in Japan was a cotton mill down in the southwestern corner of the empire, in the province of Satsuma, which has produced the best pottery and some of the greatest men. Prince Shimazu was its patron. Having learned something of modern arts and sciences from the Dutchmen who were allowed to remain on the island of Deshima, he started a laboratory on his estates in which he learned telegraphy, photography, and how to make glass, coke, and gas for illuminating purposes. A few

years later he built a factory near his summer villa, which was half arsenal and half iron foundry. He made guns there and other articles of iron, and experimented with explosives.

All the work in both institutions was conducted under his personal supervision, with the assistance of Dutch chemists, from whom he heard that much could be learned about such matters from books. So he started a retainer to Nagasaki, charged with the duty of securing whatever books on chemistry, natural philosophy, and other scientific subjects could be bought or borrowed. And an order was left with a merchant at Deshima to procure for him a copy of every scientific publication that was issued. In this way a considerable library accumulated, and the books were translated to the prince, as fast as they came, by a schoolmaster who had learned English at Deshima and whose services were secured.

One of the books contained a description of the Arkwright spinning jenny; and the prince was so fascinated that he lost no time in ordering a machine through the Dutchmen. When it came and was operated he decided to introduce it among his people as a substitute for the old fashioned spinning wheel. He built a stone factory and located a plant of 3,030 spindles, at a cost of 30,000 yen ($15,000), in a small town called Niriiso, a suburb of Kagoshima. The machines were throstles and mules made by Platt & Brother, of Bradford, who sent an English engineer over to set them up and educate the operatives. The prince treated him like an equal, built him a fine large stone house, which is now the high school building at Kagoshima, surrounded him with luxuries of every kind, and paid him a handsome salary. As the enterprise was not intended for profit, but for the purpose of introducing the art of spinning among the people, everything was conducted on a most elaborate and expensive scale, and the yarns produced were of superior quality.

The next factory was set up by Mr. Kajima, of Tokyo, in 1867; it now operates 82,000 spindles and is the largest in the empire. These were the only factories in Japan until 1879, when the government undertook to encourage such enterprises and established two well equipped plants in different parts of the country to educate operatives and demonstrate the superiority of modern machinery. It set up four more in 1880, four in 1881, one in 1882, another in 1883 and still another in 1884. They served their purpose, made machine spinning popular, and have since been handed over to private companies who are operating them with great profit.

The industry has grown so rapidly that, according to statistics gathered by the Osaka board of trade, there are now 61 factories in operation, with 580,564 spindles, employing 8,899 men and 29,596 women. The factories in course of construction, and which will be in operation during the present year, will bring the total number of spindles up to 819,115. Thirty-seven of these factories are at Osaka.

The first genuine foreign factory to be established in Japan is the Osaka Tokei Seizo Kubushiki Kwaisha, familiarly known as the American Watch Company. It was started on January 1, 1895, and turned out its first finished watch on April 10. The organizer and promoter of this company was Mr. A. H. Butler, of San Diego, Cal., who took an outfit of watchmaking machinery to Japan and induced a number of jewelers and watch dealers in Osaka to furnish $160,000 capital to pay the cost of a building and the running expenses of the business.

In the meantime the machinery was set up in temporary quarters and a number of men and boys, who had already been engaged in repairing and manufacturing handmade watches and clocks, were assembled to be educated by P. H. Wheeler, the superintendent, and his assistants.

These gentlemen say that their Japanese students show very great aptitude and skill, and that they learn much more rapidly and have a much more delicate touch than persons of similar intelligence and condition in the United States. It is difficult to explain a proposition to the Japanese, but their power of imitation is so well developed that the easiest way to teach them is to go through the process yourself and let them watch you. Almost instantly they are able to repeat it, and will continue to do so until the end of their days without the slightest variation. Another difficulty in this school of instruction was the absence of words in Japanese to describe the machinery and the parts of the watch, but the English terms were adopted and are now exclusively used.

The highest wages paid to the skilled native workmen in the factory are only 40 sen a day, which is equivalent to 20 cents in our money. The lowest wages are 10 sen (5 cents) a day, while in American factories the same labor would be paid from 50 cents to $5 a day. The capacity of the factory when fully in operation will be 150 watches a day, and owing to the low price of labor they can be sold with a profit for 50 per cent. less than the market price in the United States and Europe.

The following are the present rates of wages paid in the city of Yokohama for an average working day of ten hours: *

DAILY RATES OF WAGES PAID IN YOKOHAMA.

Occupation.	Rate per day.
Blacksmiths	$0 36
Carpenters	26
Compositors	29
Joiners	29
Laborers, ordinary	19
Plasterers	20
Porcelain artists, superior	72
Pressmen, printing offices	19
Stonecutters	31
Tobacco and cigar makers	24
Wood sawyers	29

The following are the rates of wages paid by the month:

Farm hands (men)	$1 44
Silkworm breeders (men)	1 92
Weavers (women)	96
House servants (men)	$2 80 to 8 20
House servants (women)	2 40 to 4 80

* Values stated in American gold on the basis of 2 silver yen to the dollar.

Factory labor is paid even less than these prices. Middleton & Company, one of the most prominent tea shipping houses in Japan, employ in their establishment a large number of persons, men and women, who work from 5 o'clock in the morning until 6 o'clock at night, with three intervals at 8, 12, and 3 o'clock, respectively, when they eat their rice and what other refreshments they bring with them and rest for twenty minutes or a half hour. The highest wages paid by the Messrs. Middleton are 42 sen a day, which is equivalent to 21 cents in United States currency. This is received by men who are experts in handling tea, and have acquired their proficiency by natural ability and long years of experience.

The lowest wages are paid to young boys and girls who pick over the tea leaves to remove the stems and other foreign substances. They receive 13 sen (6½ cents) a day for about twelve hours' work, not including their resting spells.

Embroidery women, who make the work that is so much prized by Americans and Europeans for decorative purposes, seldom receive more than 15 or 20 cents a day in our money, although in any other land they would be estimated as artists.

The wages paid in Yokohama are the highest in the empire, because it has a large foreign population. Money has a smaller value to foreigners and they are not such close traders as the natives. In that city the ordinary patrolmen of the police force are paid 8 yen, or $4 in our money, a month. Sergeants receive $6 and the other officials of higher rank a corresponding amount. Ordinary firemen get $3.50 a month, foremen of hose carts $7, and engineers of steam fire engines, who are supposed to possess the highest grade of talent, receive $12 a month. All are furnished two suits of clothing a year, one for summer and one for winter, and an overcoat. Night watchmen, who go about the premises of citizens, in addition to the regular police, as a safeguard against fire and burglars, get $4 a month. They patrol the districts on which they are employed from dark to daylight, and are paid by their patrons, although licensed by the city and sworn in as special police.

Investments are as safe in Japan as anywhere else in the world, although there is comparatively little foreign capital represented. All the railroads, which now represent a total of about 3,000 miles and a capital of $75,000,000, were built with local money. Not a dollar was borrowed abroad, and there are very few shares or bonds of Japanese corporations held by foreign investors. At the same time the people are not rich. There are very few men of large fortunes. I was told by a Tokyo banker that he knew of only two millionaires in Japan. One made his money in coal mining and the other is the principal owner of a great steamship company which has 100 vessels in its service and a monopoly of the coasting trade. But there are many men with small fortunes, and although wages are very low nobody is very poor. There is not an almshouse in the entire country, and you never see a beggar on the street. Occasionally some poor leper stretches out his hand as you enter one of the gilded temples, but there isn't a country in Europe or America so free from street begging as Japan.

The people as a rule are frugal and economical, and manage to save a little even when they are working for 10 cents a day. They have few wants and are temperate. You never see a drunken man in the street.

This sobriety is due to the use of tea instead of liquor as a beverage. Tea houses in Japan take the place of saloons and are about as numerous in the large cities as barrooms in New York or Chicago.

The new treaty which was negotiated by Secretary Gresham and Minister Kurino last winter at Washington makes Japan as free for foreigners as the United States, with the exception that they cannot own real estate, and by a straight reading of the text it would seem that that is not prohibited. It provides that foreigners may trade by wholesale or retail, singly or with native partners, and says that they "may own, hire, and occupy houses, manufactories, warehouses, shops, and premises, and lease land," conforming, of course, to the laws and police regulations that apply to them and the natives of the country alike.

The treaty also provides that foreigners shall enjoy all rights and privileges enjoyed by natives "in whatever relates to residence and travel, to the possession of goods and effects, to the succession to personal estate and the disposition of property;" that they shall not be required to pay higher taxes, imposts or other charges than natives; that they may freely enjoy their own religion, bury their dead according to their own rites, and shall be exempted from military service, forced loans, and all other exactions. No higher duties are to be imposed upon the products of the United States than upon those of the most favored nation, and there must be perfect equality in the treatment of Americans and natives in the exportation of merchandise. The coasting trade, as is customary in all countries, is withheld for the benefit of the citizens of Japan, but American vessels laden with cargoes for more than one port are allowed to load and unload wherever they like. The same protection is afforded to natives and foreigners in patents and trade marks, which is a very good thing, because at present there is no patent treaty between the two countries and the Japs are stealing our inventions.

Until now Japan, like China, Turkey, Egypt, and other countries which have not reached a high degree of civilization, has been subjected to what is called the doctrine of extraterritoriality. That means that the citizens of the United States or England, or any other civilized nation residing in those countries, are subject to their own laws, administered by their consuls, and not to the local authorities or courts. If an American commits a crime in Japan to-day he is tried before the United States consul-general, according to the laws of the United States, and not by the courts and laws of Japan. The same is true of citizens of European nations. If a Japanese citizen commits a crime against an American, he is tried by the local authorities. The general rule in civil as well as criminal cases is that the defendant shall be tried under the laws of his own country, and the plaintiff brings his suit accordingly.

But Japan thinks she is sufficiently civilized to administer justice to foreigners, and has long demanded release from the extraterritoriality restriction.

There is no protection for foreign patents in Japan, but any article or instrument or machine that comes into the country or that is seen abroad may be manufactured without interference or the payment of royalty; but no Japanese can obtain a patent upon a foreign invention. He must show that his idea is not only original in Japan but original with him, and if it appears thereafter that he is mistaken or has practiced a deception, his patent is canceled. The processes and implements used in all the industries of Japan have been inherited from generations far removed, and nearly all of those recently adopted are copied from foreign models.

I asked Mr. Matsudiara, the chief examiner of the patent office, at Tokyo, whether the introduction of common schools and compulsory education had improved labor.

"That is difficult to say," he replied, "but so far as I have observed education is not improving labor. The little education that the common people receive in the public schools makes them abhor labor. It has always been the custom in Japan for families to follow the same trade or occupation for centuries after centuries, but when a boy receives an education superior to that of his father he seems to feel that the old mode of life and avocation are not good enough for him. If he is a farmer's son, he wants to live in the city, and if he is the son of a mechanic, he wants employment under the government or some less laborious occupation than his family have followed. But I believe the Japanese are not peculiar in this respect. I think it is the rule all over the world that when a man acquires learning he wants to advance in other respects also and better his condition."

While the Japanese will soon be able to furnish themselves with all they use and wear and eat without assistance from foreign nations, they will be compelled to buy machinery and raw material, particularly cotton and iron. Therefore our sales will be practically limited to those articles. And the market for machinery will be limited as to time. The Japanese will buy a great deal within the next few years, almost everything in the way of labor-saving apparatus, but they are already beginning to make their own machinery, and in a few years will be independent of foreign nations in that respect also. Another important fact—a very important fact—is that they will buy only one outfit of certain machinery. We sell them one set, which they will copy and supply all future demands themselves. This will go on until the new treaties take effect, when American patents will be protected.

They have very little wood-working machinery; and very little shoemaking machinery, for the people do not wear shoes. The same is true of knitting machinery, for they do not wear hosiery. But the use of shoes and hosiery is increasing, and the people will grow into it as they have grown into other foreign notions.

Lumber is worth about twice as much in Japan as it is with us. Common lumber, which we sell for $10 and $12 a thousand feet, will bring 40 yen ($20 gold) there. This is due chiefly to the scarcity of timber and the great labor required to work it up by their primitive processes. They have been cutting timber off their mountains for 2,500 years, and although the forests have been reproduced again and again during that period, it is difficult and expensive to get logs down from the mountain side in the absence of the necessary facilities. The lumbermen usually go into the woods and cut one log at a time, which they haul out by hand or by oxen for many miles. Where streams are convenient they use them for floating timber as we do, but they have no sawmills in the mountains, although there is an abundance of water power everywhere.

All the lumber is dressed by hand. There is but one planing mill in the country—that is in Yokohama.

The Japanese make all the woodwork about their houses by hand, and most of their houses are entirely of wood. They are very skillful in all kinds of cabinet and joiner work, and more rapid than our people. Their hand-made tools are better adapted for doing close work than ours, and are kept very sharp. Some of their ships are made without a bit of iron in their composition. Everything is mortised.

Japan is one vast garden, and as you look over the fields you can imagine that they are covered with toy farms where children are playing with the laws of nature and raising samples of different kinds of vegetables and grain. Everything is on a diminutive scale, and the work is as fine and accurate as that applied to a cloisonné vase. What would an Illinois or an Iowa farmer think of planting his corn, wheat, oats and barley in bunches, and then, when it is three or four inches high, transplanting every spear of it in rows about as far apart as you can stretch your fingers? A Japanese farmer weeds his wheat fields just as a Connecticut farmer weeds his onion bed, and cultivates his potatoes and barley with as much care as a Long Island farmer bestows upon his asparagus or mushrooms or his flowers.

When grain is ripe it is cut with a sickle close to the ground. The bottom ends are carefully tied together with a wisp of straw; the bunch is then divided and hung over a bamboo pole or a rope, like Monday's washing, to dry, sometimes in the field and sometimes in the back yard, and even in the street in front of the house. When it is thoroughly cured the heads of grain are cut off with a knife, and the straws are carefully bound up and laid away in bundles. The heads are then spread out upon a piece of straw matting and beaten with a curious old fashioned flail. Another method of thrashing is to take handfuls of straw and pull them through a mesh of iron needles. After the thrashing is done the grain is taken up in a sort of scoop basket made of bamboo, and shaken by one woman who holds it as high as her head, while another woman stands by with a large fan which she waves rapidly through the air and blows the lighter chaff away from the heavier grains as they are falling. The richer farmers have separators built upon a primitive plan and turned with a crank. People often winnow grain by pouring it from a scoop upon a fan 3 or 4 feet wide, upon which it is tossed gently up and down, so as to leave the chaff in the air when it falls. Another method of thrashing is to beat the heads of grain upon a board or a row of bamboo poles.

Every particle of straw is saved, and it is put to many

uses. They make of it hats, shoes, ropes, roofs, matting, the partitions and floors of houses, waterproof coats, baskets, boxes, and a thousand and one other useful articles. They braid it for fences, too, and the finer, softer qualities are cut up for fodder.

There is little hay raised in Japan. The grass is wiry and indigestible. It cuts the intestines of animals. Some alfalfa is grown, but it does not prosper. In the neighborhood of Kobe, which is one of the seaports on the southern shore, the soil seems to be better adapted for hay, and the best beef comes from that locality.

The ordinary Japan horse, which originated in China and is called a griffin, seems to like straw and thrives upon it, but he is small and ugly, and is not capable of much endurance. He resembles the Texan broncho in appearance, but a journey of fifteen miles will use him up. They chop the straw very fine for feeding purposes, mix it with oats, barley, millet, and other grains, and by adding water make a kind of mush.

On rare occasions you find a man plowing with a cow or an ox, but more frequently with man or woman power. The Japanese plow is a section of the trunk or the branch of a young tree with a proper curve to it, and is all wood except a narrow, pointed blade, fitted into the frame work. It has only one handle.

A couple of acres is considered a large tract of land for farming purposes. Most of the farms are of smaller area, and the crops are greatly diversified. Upon such a little spot of land will be grown almost everything known to the vegetable kingdom; a few square feet of wheat, barley, corn, and millet; a plat of beans perhaps 10 feet wide by 20 feet long, an equal amount of potatoes and peas, then a patch of onions about as big as a grave; beets, lettuce, salsify, turnips, sweet potatoes, and other varieties of cereals and roots occupy the rest of the area.

The largest area of agricultural land in Japan is devoted to raising rice, perhaps as much as nine-tenths of the whole, and as that crop requires a great deal of water, the paddy fields are banked up into terraces, one above the other, and divided off into little plats 25 or 30 feet square, with ridges of earth between them to keep the water from flowing away when they are flooded. All farming lands are irrigated by a system that is a thousand years old. Some of the ditches are walled up with bamboo wicker work and some with tiles and stone.

The farmers live in villages and their farms are detached, sometimes a mile, or two or three miles away from their homes. There are no fences or other visible marks of division, but every man knows his own land, for it has been in his family for generations. Irrigating ditches and little paths are usually the boundary lines.

The official statistics of Japan show that there are 11,400,008 men and 10,948,053 women engaged in agriculture, which is nearly one-half of the total population.—Digest from the Bulletin of the Department of Labor, January, 1896.

THE CARNIVAL AT NICE.

THE fetes of the carnival were celebrated as usual in Nice, and on Sunday the joyful city saw the cortege of chariots and masks, that had come together in honor of the twenty-fourth carnival, pass through their streets and squares. Who cannot hear the enthusiastic acclamations with which the new sovereign was received, acclamations which were shared by his mule when it was installed with its master on the elegant kiosque on the Place Massena?

One of the most successful cars, and one which won all the votes, was that of the Barn Yard, drawn by an immense companion of St. Antoine, disguised as Love. The wheelbarrow that he drew was gilded and decorated with field flowers and contained numerous specimens of "animal humanity." At the back was a superb coq gaulois ready to salute the conqueror.

We are indebted to L'Illustration for the cut and particulars.

THEATRICAL SCIENCE—THE MASK OF BALSAMO.

AN experiment in entertaining physics, presented under the title of the "Enchanted Death's Head," was for a long time the attraction of the Robert Houdin Theater.

Taken up again to-day under a new form by the Isola Brothers, it is meeting with no less success, and by that very fact seems to us to be worthy of an explanation. Before entering upon this, however, we shall describe the manner in which the original or Enchanted Death's Head trick was performed.

"Ladies and gentlemen," said the operator, "upon this table we have a skull—the sad remains of what was once a man! Combining the power of a medium with that of a prestidigitator, I am going to impregnate this death's head with a mysterious fluid, after which, becoming full of life, it will be attentive and obedient to your orders."

And then, under the influence of the pretended magnetic passes of the prestidigitator who was presenting the experiment, the skull bent forward and seemed to salute the spectators. "In order to relieve you of any idea of previous preparation or of any mechanism whatever, I shall lay this head upon a plate of glass which itself rests upon two chairs, Fig. 1. The transparency of the glass and its non-conductivity to electricity are safe guarantees that I shall not invoke the aid of that wonderful magician in order to bring about the motions of the head.

"Here, now, we have a few dice, which I shall throw into the air, like this, and then cover with a handkerchief. On another hand, here we have a set of dominoes with which I shall ask one of the spectators to form a chain according to the rules adopted, that is to say, the deuce with the deuce, the six spot with the six spot, etc. After this is done, our death's head will nod as many times as there have been points made with the dice thrown at hazard upon this table. Then, despite the distance separating it from these dominoes, guessing those placed at each extremity of the chain, it will nod as many times as there are spots marked thereon." Then, to the great amazement of the spectators, the death's head, by nodding, indicated the number of points that had been thrown with the dice. Subsequently, the substitution of a skeleton hand for the skull changed the experiment only in name, the secret, which we shall now divulge, remaining always the same. Upon a table, in proximity to the prestidigitator's hand, was placed a ball of soft wax attached to a string that ran to the side scenes, where it could be pulled at the will of a confederate. After allowing the skull to be examined, the prestidigitator, in laying it upon the table, fixed the ball of wax to the top of it. After the experiment, a simple scratching with the finger nail removed every trace of the trick, which was very simple, since the least motion of the string caused the skull to rock backward and forward.

As for the guessing of the number thrown with the dice, nothing was easier. The dice were loaded, that is to say, there had been introduced into them, on the side opposite that carrying the number of spots that it was desired to obtain, a small piece of lead, which necessarily brought opposite the spectator the number known to the confederate concealed in the side scenes. With the dominoes, the process was still simpler. It sufficed to withhold one of the dominoes, say the 5 4. When the chain was formed, the two extremities gave the same number of spots, that is to say, a 5 and a 4. The confederate who had abstracted the domino from the set had merely to pull the string as many times as were necessary.

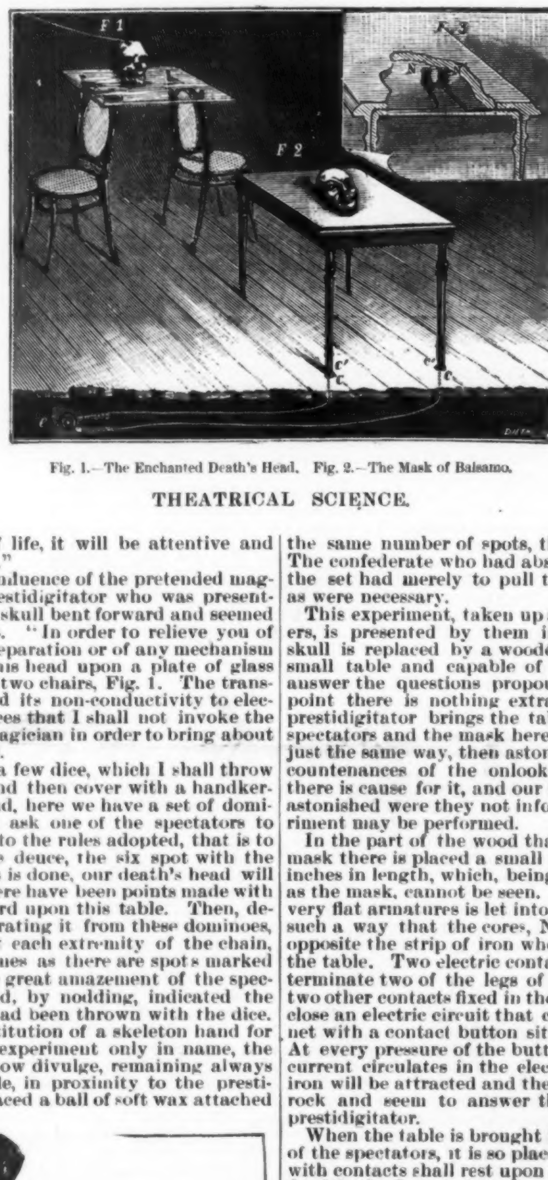


Fig. 1.—The Enchanted Death's Head. Fig. 2.—The Mask of Balsamo.

THEATRICAL SCIENCE.

This experiment, taken up again by the Isola Brothers, is presented by them in another manner. The skull is replaced by a wooden mask laid flat upon a small table and capable of rocking slightly so as to answer the questions propounded to it. Up to this point there is nothing extraordinary, but when the prestidigitator brings the table into the midst of the spectators and the mask here continues its motions in just the same way, then astonishment is read upon the countenances of the onlookers, Fig. 2. And, truly, there is cause for it, and our readers might be equally astonished were they not informed as to how the experiment may be performed.

In the part of the wood that forms the chin of the mask there is placed a small strip of iron about two inches in length, which, being painted the same color as the mask, cannot be seen. An electro-magnet with very flat armatures is let into the top of the table in such a way that the cores, N and N', Fig. 3, shall be opposite the strip of iron when the mask is laid upon the table. Two electric contacts of inoxidizable metal terminate two of the legs of the table and rest upon two other contacts fixed in the floor of the stage so as to close an electric circuit that connects the electro-magnet with a contact button situated in the side scenes. At every pressure of the button it is evident that, as a current circulates in the electro-magnet, the strip of iron will be attracted and the mask will consequently rock and seem to answer the questions put by the prestidigitator.

When the table is brought into the hall, in the midst of the spectators, it is so placed that the legs provided with contacts shall rest upon two small metallic plates fixed in the floor and thus establish a communication between the electro-magnet and the confederate—the deus ex machina.—La Nature.

THE CARNIVAL AT NICE.

POMPEIAN SURGERY AND SURGICAL INSTRUMENTS.*

By N. SENN, M.D., Ph.D., LL.D., Chicago, Ill.

A RECENT visit to the ruins of Pompeii and the Naples Museum has enabled me to make a careful examination of the ruined homes and corroded implements of the Pompeian surgeons. A visit of this kind, with its wonderful revelations at every step, is a memorable event in the life of every student of ancient surgery who has enjoyed such an opportunity. Nearly 2,000 years have elapsed since the last surgeons of that ill-fated city practiced their art. They perished or fled during that fearful eruption of Vesuvius that wiped out of existence so suddenly the two neighboring cities, Pompeii and Herculaneum, burying the former under a bed of burning ashes and incorporating the latter in a mass of lava. It is interesting to posterity that the city of Pompeii, with all its antique treasures, has been preserved for centuries under the removable mantle of the product of volcanic action which has made it possible for the interested archæologists of the present century to unveil to us the works of art and science of 2,000 years ago. A walk through the streets of the recently uncovered city of Pompeii brings vividly to the mind of the visitor the life, work, virtues, and vices of its former inhabitants. The old aqueduct that supplied the city with pure water from the mountains is well preserved and remains as one of the marvels of engineering of that time. The pavements of the streets can compare favorably with those of our day. The bare walls of public and private buildings testify to the unrivaled perfection masonry had attained at that day. The crude stone mills, o

* Read before the Alumni Association of Cook County Hospital, November 18, 1895.—From the Columbus Medical Journal.

rated by human power, furnished the city with flour, which in the adjacent bakery was converted into bread.

The enormous wine jugs, so numerous in places where wine was sold and drunk, remain as lasting mementoes that the Pompeians were by no means prohibitionists. The numerous houses of prostitution, both public and private, remain as silent witnesses of a vice which appeared to have been unusually prevalent at that time. The capacious forum, amphitheater, comic and tragic theaters, that remain in a wonderful state of preservation, show that the people of that day—male and female, old and young—enjoyed the glittering stage and the bloody contests of the gladiators. The public bath house is a marvel of its kind, and it is doubtful if in its artistic design and luxury it could be duplicated to-day. The private dwellings are all constructed on the same plan—masterpieces of comfort and sanitary construction. The numerous fountains furnished pure water for man and beast. The temple of Esculapius is one of the prominent landmarks of the former city, and fortunately time and the elements have dealt gently with its precious contents. In the center of the capacious anteroom stands the altar of pure marble, beautifully carved, at which the priests of old worshiped in the interests of suffering humanity. It is here where the sick, the maimed, and the injured sought relief. As I stood behind the altar where so many of the disciples of Esculapius had stood and performed their sacred functions, it seemed to me that I could hear the pitiable appeals of the suffering Pompeians and the sound advice and sweet words of consolation of the ministering priest. With the temple of Esculapius will always be associated the early history of medicine and the struggle between disease and its successful treatment.

A walk through the narrow, stone-paved streets of the uncovered part of the ruins of Pompeii is necessarily attended with serious thoughts of the past and present. The wider streets show deep grooves made by the chariot wheels, while the narrower streets were reserved for pedestrians. The one-story buildings, both public and private, show a singular uniformity in their construction—evidence that the Pompeian architects and builders had in view more the comfort and health of their occupants than a desire to exhibit their talent. The many shops in the principal street were the homes and business places of merchants who supplied the citizens with the luxuries and necessaries of life. A large building on the corner of two streets served as a drug store, where crude drugs were dealt out to those in need of remedial agents. The proprietor of this primitive pharmacy—living, as he did, next door to a public house of prostitution—in order to protect himself and family against intrusion of an undesirable nature, found it necessary to place above the entrance a sign to indicate to the prospective customer legitimate character of his business, and to direct him properly if he was in search of pleasure.

Excavating.—The first discovery of the ruins of Pompeii was made in 1595, and the first attempt at excavation was made in 1748. But it was not until 1860 that systematic exploration was pursued, and since then it has been scientifically carried on as far as means and opportunity have permitted. It is estimated that the whole of Pompeii will be cleared in about fifty years' time. At the time of my visit to the ruins excavation was in active progress. With pickax and shovel the ashes and pumice stone which cover and fill the streets and houses are loosened, and a small army of boys is employed to convey the same in baskets to handcarts, which are propelled by hand power over a temporary railway track. The workmen at this time were engaged in cleaning a large house, evidently an aristocratic residence, with walls and ceilings beautifully decorated by paintings, representing female beauty and animal life. The pictures are so well preserved that it seems almost next to impossible to realize that the artist and former owner are dead, and that they have been buried in the ruins for nearly 2,000 years. At this place the houses are about 10 feet under the surface of the soil. The workmen exercise great care in bringing all objects of interest in as perfect a condition as possible to the surface, after which they are brought to the museum at Naples, where they are examined, classified, and deposited in their appropriate places. The Naples Museum has become a great treasure house, in which the students of ancient history for ages to come will have an opportunity to study the interesting lesson of the high civilization of remote ages.

The objects of special interest to the surgeon in this great collection of ancient art are contained in a glass case, and are properly numbered and described in the catalogue. They are the

Surgical Instruments.—These instruments were found in a house which has since been called the "Surgeon's House." They are made of bronze, and some of them show a high degree of artistic workmanship. Some of them show the destructive effect of heat and oxidation, while others are in a state of excellent preservation, as will be seen from the illustrations. The illustrations are taken from specimens from the Naples Museum by Domenico Monaco and E. Neville Rolfe, Naples, 1895.

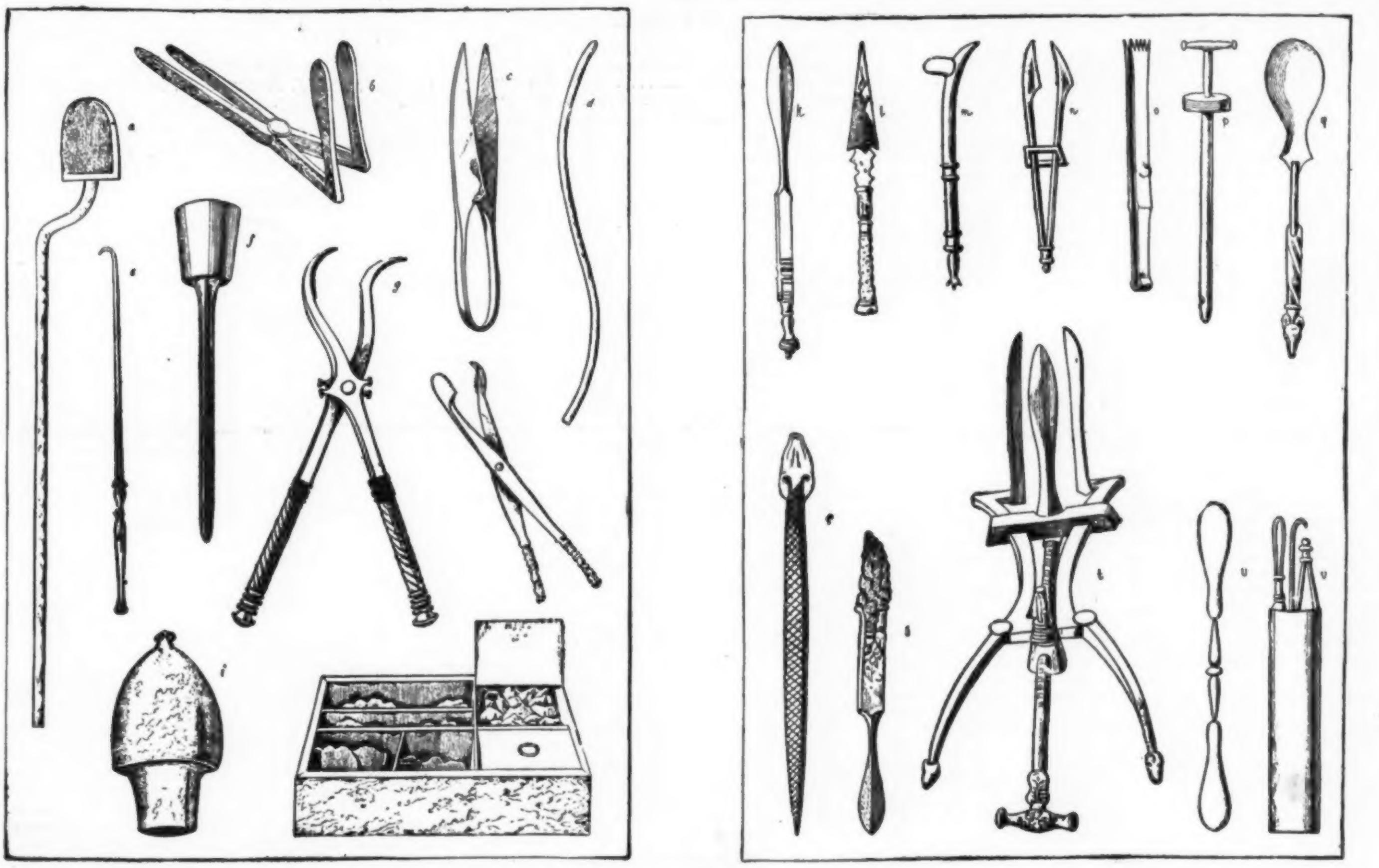
A quadrivalve speculum, which is one of the most interesting and perfect specimens of the collection, is, unfortunately, not among the illustrations.

a. Actual cautery. Length 10 inches. b. bivalve speculum working on a central pivot. Length 6 in. Width, when open, 2½ in. c. Scissors with a spring-like shears. Length 4 in. d. A male catheter, which is almost a facsimile of the one devised by J. L. Petit in the last century. At the closed end is an eye, as in the modern instrument. Length 10½ in. e. Hook. Length 6 in. f. Point of injection syringe, with eight small perforations near the distal end. The other end was, no doubt, filled with a syringe. Length 6 in. g. Pompeian forceps, formed of two branches, crossing and working on a pivot. Each branch is filled with an engine turned handle and a spoon-shaped blade. A powerful forceps, undoubtedly used for the extraction of foreign bodies. Length 8 in. h. Forceps with serrated bite. Length 4½ in. i. Cupping glass of bronze. Height 6 in.; diameter 3 in. j. Medicine box with medicines, 5 × 3 in. k. Spatula for mixing ointments. Length 7 in. l. Lancet for bleeding. Length 5 in. m. Fleam for bleeding horses. Length 5½ in. n. Forceps. Length 4½ in. o. Toothed dissecting forceps with the engraved name A. C. A. A. G. L. V. S. F. Length 7½ in. p. Trocar for tapping, with a hole at the end for the escape of the fluid. Length 6 in. q. Small spoon with bone handle, ending in the head of a ram. Length 5½ in. r. Female catheter. Length 4 in. s. Bistoury, the blade oxidized and the handle in bronze. Length 5¾ in. t. Trivalve speculum, an instrument which, like the bivalve and the quadrivalve, has been much discussed by archæologists and physicians. It is composed of three valves standing at right angles to the rest of the instrument, and jointly dependent on one another in the expansion transmitted only to one of them. By turning the screw, one valve is drawn nearer the operator, and this forces the other two to open in a sidelong direction. The instrument can be held by the two curved handles with the left hand, while the right hand turns the screw. Length 8½ in. Width expansion of the valves 1½ in. u. Spatula. Length 7 in. v. A metallic case containing surgical instruments. Length 8 × ¾ in.

These are some of the most important instruments found in the ruins of Pompeii, and which were employed by our ancestors two thousand years ago in the practice of surgery. I searched carefully, but without avail, for traces of needles or something else which would indicate that at that time wounds were sutured. The collection contains no saws, trephines, chisels or any other instruments for operations upon bones. All of the instruments, with the exception of the specula and catheters, are diminutive in size as compared with the same instruments of less remote and modern times. The absence of saws and chisels is noteworthy, as among the agricultural instruments these tools are represented by specimens of a high degree of perfection.

In the writings of Hippocrates, raspatories, mallet and trephine are mentioned, and consequently must have been used in operations upon bones other than those of the skull. Hippocrates gives very minute directions as to the use of the trephine in the treatment of fractures of the skull:

"With regard to trepanning, when there is a necessity for it, the following particulars should be known: If you have had the management of the case from the first, you must not at once saw the bone down to the meninx, for it is not proper that the membrane should be laid bare and exposed to injuries for a length of time, as in the end it may become fungus. And there is another danger if you saw the bone down to the meninx and remove it at once, lest in the act of sawing you should wound the meninx. But in trepanning, when only a very little of the bone remains to be sawed through, and the bone can be moved, you must desist from sawing and leave the bone to fall out of itself. For to a bone not sawed through, and where a portion is left of the sawing, no mischief can happen, for the portion now left is sufficiently thin. In other respects you must conduct the treatment as may appear suitable to the wound, and in trepanning you must frequently remove the trepan, on account of the heat in the bone, and plunge it into cold water. For the trepan, being heated by running round, and heating and drying the bone, burns it and makes a larger piece of bone around the sawing to drop off than would otherwise do. And if you wish to saw at once down to the membrane and then remove the bone, you must also in like manner frequently take out the trepan and dip it into cold water. But if you have not charge of the treatment from the first, but undertake it from another after a time, you must saw the bone at once down to the meninx with a serrated trepan, and in doing so must frequently take out the trepan and examine with a sound and otherwise along the track of the instrument. For the bone is much sooner sawn through, provided there be matter below it and in it, and it often happens that the bone is more superficial, especially if the wound is situated in that part of the head where the bone is rather thinner than in other places. But you must take care where you apply the trepan and see that you do so only where it appears to be particularly thick, and, having fixed the instrument there, that you frequently make examinations and endeavor by moving the bone to bring it up. Having removed it, you must apply the other suitable remedies to the wound. And if, when you have the management of the treatment from the first, you wish to saw through the bone at once and remove it from the membrane, you must in like manner examine the track of the instrument frequently with the sound and see that it is fixed on the thickest part of the bone, and endeavor to remove the bone



SURGICAL INSTRUMENTS FOUND IN POMPEII.

by moving it about. But if you use a perforator you must not penetrate to the membrane. If you operate on a case which you have had the charge of from the first, but must leave a thin scale of bone, as described in the process of sawing."

As Hippocrates at one time lived and practiced in Athens during a great epidemic, it appears strange that his teachings in reference to the treatment of injuries of the skull should not have reached Pompeii, as evidenced by the absence of trepans and other bone instruments in the "House of the Surgeon."

If we judge the work of the Pompeian surgeon from the collection of instruments he left behind him, it is evident that bloody operations were confined to bleeding, cupping, extraction of foreign bodies and opening of abscesses. The metallic medicine box, the spatula and spoon indicate that the surgeons of that time made free use of medicines and ointments in the treatment of injuries and disease. The instruments and implements of wood, splints, etc., were of course destroyed by fire and heat, and their absence in the collection leaves undoubtedly a large gap in the surgical resources of the Pompeian surgeon.

The surgeon's house does not differ from the private house in its vicinity. It is roofless like the rest, all that remains being the bare walls. It is here that most of the surgical instruments were found. This house was undoubtedly occupied by the principal surgeon of Pompeii, who ministered to those in need of surgical aid. It is here that bleeding and cupping were practiced for all kinds of ills, real and imaginary.

It is difficult to imagine what transpired from day to day. That the surgeon was a busy man there can be but little doubt. Competition was then not as active and pressing as it is now, and it is therefore safe to assume that the capacious waiting room was crowded day after day by patients anxious to be bled, cupped or burned. These large walls, if they could talk, could tell of many sad and exciting scenes. Fainting from loss of blood and writhing under the actual cautery must have been frequent and familiar sights. How often the neighborhood must have been disturbed by the cries of the suffering and the shrieks of the tortured! How often the atmosphere and adjacent streets must have been stifled with the smell of burned human flesh! Let us hope that the master escaped, leaving in his haste his instruments of skill and torture as lasting mementoes of his so suddenly interrupted professional career. The house is deserted and silent now, a permanent reminder of the great antiquity of the art of surgery.

If the last representative of Pompeian surgery could return to-day and behold the improvements in surgery which have been made since his time, he would indeed be astonished and amazed. What would be his surprise if he could visit one of our modern hospitals and inspect an aseptic operating room. He would find his old occupation gone. No need now for lancet, cupping glass and actual cautery. He would find the science of surgery developed to a wonderful degree of perfection and its practice in consonance with its principles. He could make use of anesthesia to prevent pain, Esmarch's bandage to guard against hemorrhage, and operate under aseptic precautions to protect accidental and intentional wounds against complications the treatment of which made up a large part of the work of the ancient surgeon.

He would perhaps be astonished to learn that since Pompeii was buried surgery not only came to a standstill, but retrograded for centuries, and that its present state of perfection is owing largely to the improvements and advancements made during the present century. Let us not forget, however, that our colleagues of the distant past, possessed of a primitive knowledge of anatomy, physiology and pathology, and armed with few and imperfect instruments to practice their art, labored faithfully in the interest of suffering humanity and unquestionably did much toward prolonging the lives and adding to the comfort and happiness of those who were intrusted to their care.

Pompeian Surgery.—There can be but little doubt that the Pompeian surgeons practiced surgery in accordance with the teachings of Hippocrates.

Hippocrates, who is justly entitled to be called the father of medicine, was born on the island of Cos, 450 B. C.; hence his lifework was contemporaneous with the early history of Pompeii. It is not difficult to conceive that his teachings penetrated to this city, or that some of its surgeons might have been his pupils. In all probability, Pompeian surgery was Hippocratic surgery. As has been remarked before, the instruments which have been recovered from its ruins so far seem to indicate that no major operations were performed at that time and that the surgeon's work was limited to cupping, bleeding, the treatment of injuries and the performance of minor operations. The discovery of a number of very ingenious specula in the "House of the Surgeon" furnishes us with positive evidence that at that time gynecology was not practiced as a specialty, but constituted a legitimate part of the surgeon's work.

The fleam for bleeding horses found in the instrumentarium of the Pompeian surgeon goes to show that he extended his sphere of usefulness to the domestic animals, which furnished him with an additional field of observation, and undoubtedly added materially to his income.

That the surgeon of Pompeii was a man of means and good social position is amply testified to by the size and location of his house. This house is capacious, and is located in the aristocratic part of the city. A liberal income undoubtedly rewarded his labors and placed him in a position to enjoy the luxuries of life, which seems to have been the main object in life of the mass of the people at that time. The existence of a separate house, occupied as a pharmacy, shows that the people then, as now, had great faith in the healing powers of herbs and drugs, and the medicine box found in the "Surgeon's House" was replenished from time to time from this source, and its contents were undoubtedly frequently made use of by the surgeon in the practice of his profession.

The bicycling fever is responsible for the great increase in the price of raw rubber. It is estimated that 1,500,000 pounds more has been used during the last year than ever before; this will be doubled next year. The price is raised to 82 cents from 61 cents.

SELECTED FORMULÆ.

Gergurine.—An application for chaps (gergures), blisters, etc., especially for chapped lips and hands:

Gelatin	100 parts.
Egg albumen	200 "
Salicylic acid	10 "
Rosewater	2,250 "
Glycerine......sufficient to make	5,000 "

Dissolve the gelatin in the rosewater by the aid of the water bath and very gentle heat. Let cool, and, before it jellifies, add the albumen and stir together. Dissolve the salicylic acid in the glycerine, and, after again applying heat to the gelatin solution, add it to the latter, stirring constantly. When the mixture is quite homogeneous, remove from the fire and filter through a warm water apparatus directly into receptacles in which it solidifies. Instead of rosewater, any other distilled perfumed water may be used.—National Druggist.

For Tan, Freckles, etc.—

Rosewater	6 ounces.
Glycerin	½ ounce.
Bitter almond water	2½ drachms.
Tincture benzoin	2½ "
Borax	1½ "

Apply night and morning.—Chevasse.

Ground Glass Imitation.—An imitation of ground glass may be effected by rubbing up, as for oil colors, a sufficient quantity of sugar of lead with a little boiled linseed oil, and distributing this uniformly over the pane from the ends of a hog hair tool, by a dabbing, jerking motion, until the appearance of ground glass is obtained. It may be ornamented when perfectly hard by delineating the pattern with a solution of caustic potash, giving such time to act as experience dictates, and then expeditiously wiping out the portion it is necessary to remove.

Fertilizing Mixture for Lawns.—

Nitrate of sodium	80 parts.
Superphosphate of calcium	100 "
Guano	200 "
Gypsum	120 "

This amount is sufficient for one acre, and should be applied once or twice a year. This yields excellent results.—B. & C. Druggist.

Chemical Food for Plants.—

Sulphate of ammonium	4 parts.
Nitrate of potassium	2 "
Sugar	1 part.

About 40 or 50 grains should be added to 1 gallon of water and applied once or twice a week.

To Avoid Cracks, Curving, and Warping in Hardening Steel.—The following directions should be observed: 1. Thin, flat pieces should be immersed, edge foremost, with uniform velocity. If allowed to touch the water with the broad surface, they would warp. 2. Articles considerably thicker on one side than on the other—for instance, razors—must be immersed with the thick side foremost, as otherwise the thin side would show cracks. 3. The article is to be immersed in the hardening water as far as it has been made red hot; otherwise a crack is formed on the place of immersion. 4. In hardening cast iron articles tipped with steel, it must be taken into consideration that cast iron contracts more strongly than steel, and that consequently the article would curve every time. To avoid this, curve the article before hardening to the opposite side.

Annealing of Bronze.—This process is especially employed in the preparation of alloys for cymbals, tamtams, bells, etc. These alloys themselves are brittle, and the instruments cast from them become soft and sonorous only by immersing them, while still hot, in cold water, then hammering, and finally again heating and slowly cooling. While steel acquires hardness by quenching, a copper tin alloy has the remarkable property of becoming sensibly softer and more ductile when quickly cooled, and this property is made use of by heating the alloy to a dark red, or, in case of thin objects, to the melting point of lead, and then immersing in water. The alloy thus treated can be worked under the hammer and stretched without cracking or breaking.

A Simple Freezing Apparatus.—H. N. Warren suggests that a simple and powerful freezing apparatus can be made by placing 10 cubic centimeters each of ether and carbon disulphide in a small distilling flask, which is placed in the water to be frozen. Through the neck of the flask is passed a rubber tube terminating in a glass point, which should almost touch the surface of the ether. A current of air is then forced into the flask by means of a constant-acting bellows. As the mixture vaporizes, the temperature sinks almost to zero, and ice begins to form. The inventor has frozen a liter of water in this manner in half an hour when the temperature of the room was 70° F.—Bulletin of Pharmacy.

To Powder Camphor.—To powder camphor so that it will not again agglomerate, dissolve it in 1½ parts of alcohol, precipitate by the addition of 4 parts of water, collect the precipitate, wash with an abundance of water and dry.—Canadian Druggist.

Listerine.—Of course we cannot give the genuine formula for this article, but there have been many imitation formulas proposed which are pretty close guesses.

Fortschritt says this is a close imitation:

Benzoin acid	8 grammes.
Borax	8 "
Boric acid	16 "
Thymol	2·4 "
Eucalyptol	10 drops.
Oil wintergreen	10 "
Oil peppermint	6 "
Oil thyme	2 "
Rect. spirit	180 grammes.
Water to make	1000 "

This still lacks baptisia. It is claimed by the makers that this is one of the ingredients used.—S. F. and Pac. Druggist.

Balsam Varnish.—Dr. Howard's antiseptic varnish for coating cavities in teeth preparatory to filling consists of Canada balsam, to which has been added mercuric-chlorid and thymol. The whole is evaporated over a water bath from twenty to twenty-eight hours, and finally dissolved in chloroform. The proper consistency can only be determined by experience and careful observation, and it is upon this that its usefulness depends. When improperly prepared it is valueless. It is not, of course, intended to retain fillings, but to aid in their adaptation, and to act as an anti-thermal and protective coating.—Dental Practitioner and Advertiser.

To Prevent the Caking of Table Salt.—It is claimed that by adding to salt glycerin, or a mixture of glycerin and cotton seed oil, in the proportion of 10 oz. of glycerin to 125 lb. of salt, or 2 to 3 oz. of glycerin and 2 to 3 oz. of cotton seed oil, the caking of table salt is entirely prevented.

Paste for Cleaning Show Windows.—

	Parts.
Castile soap	2
Water	3

Dissolve the soap in the water and add:

Prepared chalk	4
Vienna chalk	3
Tripoli, fine	2

Stir into a homogeneous mass and put in moulds to set.—Neueste Erfind- und Erfahrungen.

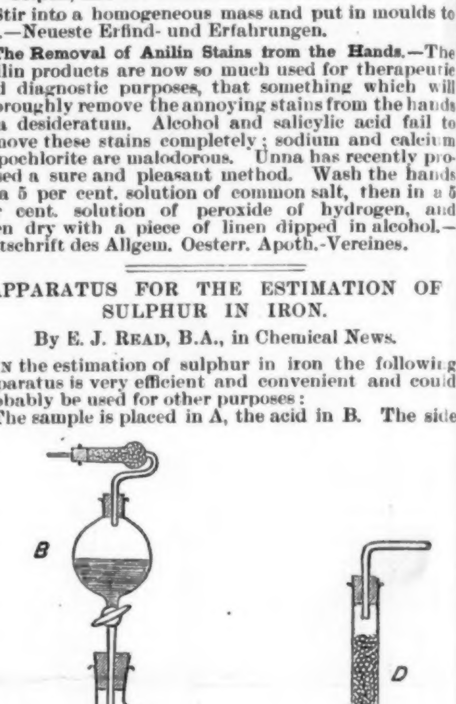
The Removal of Anilin Stains from the Hands.—The anilin products are now so much used for therapeutic and diagnostic purposes, that something which will thoroughly remove the annoying stains from the hands is a desideratum. Alcohol and salicylic acid fail to remove these stains completely; sodium and calcium hypochlorite are malodorous. Unna has recently proposed a sure and pleasant method. Wash the hands in a 5 per cent. solution of common salt, then in a 5 per cent. solution of peroxide of hydrogen, and then dry with a piece of linen dipped in alcohol.—Zeitschrift des Allgem. Oesterr. Apoth.-Vereines.

APPARATUS FOR THE ESTIMATION OF SULPHUR IN IRON.

By E. J. Read, B.A., in Chemical News.

In the estimation of sulphur in iron the following apparatus is very efficient and convenient and could probably be used for other purposes:

The sample is placed in A, the acid in B. The side



tube of A is connected with the wash bottle, C, to which a calcium chloride tube, D, filled with glass beads, is attached. The tube of D dips a regulated distance below the surface of the absorbing liquid, so that this is forced up among the beads by the passage of the evolved gas, and a most efficient absorption is obtained with the use of only a small quantity of absorbent. If the inlet tube of C dips below the surface of the liquid, it must be raised before disconnecting the apparatus, to prevent loss of liquid. The operation is preferably conducted under reduced pressure, and a current of pure air may be run through the apparatus at the conclusion to sweep out the remaining traces of gas from A.

EXPLOSIVE MIXTURES OF GASES WITH AIR.

At a recent meeting of the Chemical Society a paper was read by Professor Frank Clowes, D.Sc., on "The Composition of the Limiting Explosive Mixtures of Various Combustible Gases with Air." A series of experiments were made with mixtures in varying proportions of each combustible gas with air. A flame was brought into contact with each mixture, sometimes above and sometimes below, and it was noted whether the mixture burnt black independently of the external air. For each combustible gas there was thus obtained a lower percentage below which the mixture would not burn independently, and a higher percentage, above which the gas burnt independently only when it was supplied with more air. The limiting percentages were as follows: For methane, 5 and 13; for hydrogen, 5 and 72; for carbon monoxide, 13 and 75; for ethylene, 4 and 22; for water gas, 9 and 55; for coal gas, 5 and 28. It was also proved that many mixtures which were outside but close to the above limits, and which could not be fired from above, could be fired from below. Hence it is inferred—(1) That the limiting explosive mixtures for different combustible gases vary widely. (2) That methane shows the narrowest limits, hydrogen the widest limits. (3) That the risks of a mixture being fired explosively increase with the different gases in the following order—methane, ethylene, coal gas, water gas, carbon monoxide, hydrogen. (4) That the risk of explosion is greater when the mixture is kindled from below than when it is kindled from above.—The Science and Art of Mining.

ENGINEERING NOTES.

The landing of the Hamburg-American line steamers' passengers at Plymouth has induced the Great Western to shorten the time of its run from that port to London. Special boat trains are now run, which make an average speed of about 55 miles an hour.

The tendency to build steamers and sailing vessels of exceptionally large tonnage has been a marked feature in shipbuilding during the past year. The largest steamers launched in Great Britain during the year were: the Georgic, 10,077 tons; Victorian, 8,767 tons; Armenian and Cestrian, 8,765 tons each; and the American, 8,196 tons. The United States launched the St. Paul, 11,629 tons; Germany, the five-masted bark Potosi, 4,027 tons; and France, the Wulfran Puget, 3,062 tons. The great lakes launched the Aurania, of 3,113 tons.

Speaking of the removal of the wind gage from the new United States army rifle, Gen. Flagler says: "The object of all target practice is to enable the soldier to shoot better in battle. While it is obvious that the wind gage might in some cases enable the marksman on the target range to hit the bull's eye oftener, it is equally obvious that this would not train the soldier to shoot better in a battle, because he cannot and will not use the wind gage in battle, except possibly in rare cases where special marksmen would shoot at an individual enemy at long range."

Lieut. W. Stuart-Smith, U.S.N., suggests that many unexplained boiler explosions may be due to "resonance." When steam is admitted to the engine its speed in the pipe may be as high as 100 ft. a second. At the moment of cut-off the flow is suddenly checked and the momentum of the steam causes it to "bank up at the engine end of the pipe, with a rise in pressure over that in the boiler." There is then a reaction in the direction of the boiler, with an increase in pressure there. In this way "an accumulative action might be produced," which would ultimately result in collapse of the boiler.

The Maritime Canal Company's engineers, as the result of a preliminary survey, estimate that the cost of the Nicaraguan Canal will be $70,000,000. The President's Commission has lately estimated that a canal built upon the route of the same survey will cost nearly double that sum, or $130,000,000. The Commission states that an exhaustive survey which would gather full data upon which a positive estimate could be made would cost $130,000. In view of the magnitude of the undertaking, this is not an extravagant figure, and it is to be hoped that such a survey will be at once carried through.

The report of the Board of Consulting Engineers to the Dock Board of the city of New York says: "No material changes in the piers are desirable. As now built these piers serve their purposes admirably. The plan adopted by some of the steamship lines of two-story sheds, the best example of which is pier 14, would seem to give as much capacity as is desired on a pier. It must be remembered that the imports of this port are generally manufactured goods consigned to New York houses, and for the most part unloaded directly on the piers. It appears to the board that the provision of suitable graving docks is a proper function of the Department of Docks, and that facilities similar to those furnished in Liverpool and Southampton should be furnished in the port of New York."

Check Nuts.—It is common in railway practice, says the Electric Railway Gazette, to place two nuts on any thread requiring a nut, and to have one nut lock the other. One, the check or lock nut, is usually thinner than the other, and is invariably put on last. A little reflection will show how utterly absurd is this practice. The nut that does the locking presses forward the nut on which the strain comes; the latter transmits all the load it may be carrying to the check nut. Therefore, if either of the nuts is thinner than its mate, it should be put on first, for it becomes not much more than a washer as regards holding, after its companion has been crowded upon it to lock it in place. The outer nut has to carry the whole load, and in addition any stress that may have been imposed by setting the two nuts together.

The Pittsburg Reduction Company, says the Aluminum World, are now ready to furnish alloys of aluminum to replace brass for casting purposes, which will have a specific gravity of between 3·0 and 3·15, where brass has a specific gravity of from 8·21 to 8·44; the brass being 2·57 to 2·70 times heavier than the aluminum alloys. These alloys contain a larger proportion of aluminum than the brass does of copper; and when the selling price of the brass ingot is multiplied by its factor of relative weight, the aluminum alloy is now being sold at as low, and in some cases at a lower price, bulk for bulk. These alloys have a tensile strength of from 46 000 pounds to 50,000 pounds per square inch, in hard rolled sheets. In castings, brass has a tensile strength of from 18,000 to 30,000 pounds per square inch, with an elastic ratio of from 25 to 35 per cent.

At a recent meeting of the Cleveland (England) Institution of Engineers, Mr. Jeremiah Head gave some interesting comparisons based on his experience of American and English railway cars and travel. The average length of a journey in the United Kingdom is 7·2 miles; in the United States it is 22 miles—three times as much. Comparing the two systems of springs in use, he says that "if time allowed, the carriage (Eng.) would be raised one-half inch when the wheel rolls over a one-half inch obstruction, causing a blow on the carriage equivalent to 7·8 foot pounds;" but "by reason of the arrangement of levers" on the American truck, "when the wheels pass over a one-half inch obstruction, the car body is raised but one-twelfth inch, with a blow equivalent of 0·92 foot pound." He noticed that whereas it is easy to count every rail joint on an English road, on the New York Central it was impossible to do this, for the reason that "there were no jolts to count." The dead load of a 15-ton English car carrying 30 passengers is only one-half ton per passenger; on an American car of 36 tons weight, carrying 30 passengers, it is one and one-fifth tons per passenger. An English coal car carries 1,120 pounds dead weight for each ton of coal; an American car only 672 pounds per ton.

ELECTRICAL NOTES.

German electricians term the lost currents which circulate through the earth in the return circuits of railways "vagabond currents."

Dr. Banti, of Rome, Italy, editor of L'Elettricita, who installed the new electric railway system in Rome, received a shock from a 600-volt circuit. The shock deprived him of his eyesight for several days.

A short time ago the Cuban insurgents captured a small town and telephoned the commander of the Spanish fort in the suburbs to surrender. The matter was discussed over the wire and an amicable agreement was reached and the fort was surrendered.

Electric heat, it is said, has been applied with success to the thawing out of frozen water pipes in England, a doubled wire being run into the pipe until it meets the obstruction, and then the current is turned on, and as the current passes it becomes hot and melts the ice.

A storage battery is in use in Germany in which the lead plates are rendered extremely porous by the admixture of granulated pumice stone. The air contained in the pores of the stone expands when the lead is melted and forms a large number of cells in the plate. It is said that the porosity is so great that a plate 9 by 7½ inches will absorb 5½ ounces of water.

In Lancashire, England, the search light has been put to a novel use. The employes of a mill struck, and the manufacturer determined to keep the mill running. A search light was obtained and erected on a prominent part of the building, the idea being to prevent the strikers from setting fire to the temporary habitations of the new hands. During the continuance of the strike it was used nightly.

The Western Union Telegraph Company added over 10,000 miles of copper wire to its system of lines during the year ending June, 1895. The telegraph wire weighs about 199 pounds per mile, and the saving in weight due to the use of a copper conductor, combined with its increased capacity and diminished liability to interruption from atmospheric conditions, make copper more economical, notwithstanding the greater first cost.

A Metallic Product from the Emerald.—The French chemist, M. Lebau, has prepared pure glucinum from the emerald, by heating it in an electric furnace and treating the residue with hydrofluoric acid. Glucinum is a beautiful white metal, which is stronger than iron and of greater electrical conductivity than copper or silver; hence it would be very useful for electrical engineering if it could be obtained in commercial quantities.

The Westinghouse Electric and Manufacturing Company has lately received orders to equip an electric railway in the Isle of Man. Another order has come to hand for electric railway apparatus for the city of Coventry in England, and a third for electric motors and railway generators for a road at Cape Town, South Africa. The company is also about to ship equipment to fill an order for an electric railway apparatus at Bangkok, Siam, India.

Foundry Electric Cranes.—At the Sandycroft foundry, in England, some novel electric cranes are in use. Pieces of iron and steel, weighing sometimes as much as two tons, are raised by electro-magnets. The current is supplied from the electric power and lighting plant. One magnet takes a current of 5½ amperes at a pressure of 110 volts to excite it. The current is regulated by a controller and switch. By the use of this magnet three men do the work of six men in one-sixth of the time.

A new process of coloring leather has been tried in Germany. The leather is placed upon a zinc table which forms the positive pole. The dyeing material is poured over this, and the negative pole connected to the leather. Under the action of the current the coloring matter penetrates the surface of the leather. Patterns may be made upon the leather by covering it with a pattern plate connected to the negative pole. The parts directly beneath the leather will be lighter than those exposed.

Electric Motors in Furnace Work.—A new application of electric motors has been made in a German furnace plant. The Martin furnace at the Lauchhammer works, near Riesa, has to be charged eight times daily with about thirteen tons of iron. This has hitherto been done by hand, at a great expense of time and money, but with the new feeding apparatus one man can do in a short time the work of four men who have hitherto been necessary, and he is not subjected to anything like the same temperature.

Signor Murani, in L'Elettricita, describes some experiments on the influences of vibration on the resistance of wires. To avoid the heating due to friction, the vibrations in a series of metallic wires were induced by an electromagnetic tuning fork, wires of hardened iron, platinum, hard steel, hard copper, German silver, and manganese being tested, and in no case was any variation in the electric resistance detected by the most delicate methods. It is consequently concluded that the resistance of metallic wires is not altered by vibrations, all results to the contrary obtained by other observers notwithstanding.

Electric Traction in Europe.—In one year the number of electric railways in Europe increased from 43 to 70, and the aggregate length of lines from 189 miles to 434 miles, says the Engineer. The total capacity of central stations has grown in the same time from 10,650 to 18,150 kilowatts, and the number of motor cars from 538 to 1 286. Germany heads the list with 227 miles of line; France follows with 59·7 miles; England, with 42·6 miles; Austria-Hungary, with 27·8 miles; Switzerland, with 23 miles; Belgium, with 13·4 miles; Italy, with 11·7 miles; Spain, with 8·7 miles; Russia and Servia, with 6·2 miles each; Sweden and Norway, with 4 miles; and Roumania, with 3·3 miles. Germany has 22 separate lines in service; England has 13; France, 11; and Switzerland, 8. Out of 70 lines, 55 lines use the trolley system with overhead conductors.

MISCELLANEOUS NOTES.

The largest collection of ornithological specimens in the world is that in the British Museum, which contains 300,000 specimens. The late Mr. Henry Seebohm, the well-known naturalist, bequeathed his collection of 17,000 birds to the same institution.

At the present time there are owned and controlled by the railroads and private car companies of America nearly 1,250,000 freight cars, or, in other words, enough cars to make two continuous trains reaching from Boston to San Francisco, with an engine for every 45 cars.

The Calumet and Hecla copper mine, at Red Jacket, Mich., claims to possess the deepest shaft in the world, and also that its cross section shows the largest area. It measures 22 × 14½ ft., its area therefore being 319 ft., and it is 4,900 ft. in depth. The hoisting will be done by two pair of 3,000 horse power triple expansion engines.

A Dalziel telegram from Shanghai says that the contract for the new Chinese railways recently decided upon stipulates that they are to be constructed at a price of 40,000 taels per mile, 80 pound rail being used. The contract for these, the telegram adds, will probably be placed in England, while that for the rolling stock will go to America.

The whaler Active, of Dundee (Scotland), reports a phenomenal catch, while engaged in the Greenland fishery last season. The outfit of the Active cost $5,150. The owners receive one third of the profits, and after this is paid there will be a sum of $20,000, equal to a dividend of 360 per cent. on the investment, to be divided among the shareholders.

The total expense of paving, including the appropriations to the Department of Public Works, the sum raised by the Department of Street Improvements, and the sum raised from the sale of bonds, brings New York's outlay for pavements of all kinds up to $2,000,000 a year. The city has now 330 miles of stone pavement, 150 of asphalt and macadam, but no wooden pavements to speak of.

The self-ignition of cotton waste has recently been made the subject of careful experiment. A small amount of the common waste was saturated with linseed oil, wrung out, and inclosed in a wooden box into which was fitted a thermometer. Shortly afterward the temperature in the box, which was 70° C. at the commencement of the experiment, rose to 173° C. and the contents commenced to smoke. On opening the box the contents burst into flame.

Great economy is claimed for the process of scouring wool with naphtha. The natural oil of the material is carried out of the wool by forcing naphtha through it under pressure. The process of cleansing with alkali exercised a more or less injurious effect upon the wool, but the new process is said to "leave the fleece in better condition than when treated by any other system." It is claimed, moreover, that the grease, which has been extracted from the wool, may be recovered from the naphtha, and that it is then available for the manufacture of soap.

Common nitric acid is not an effective test for 18k. gold, its action being the same upon this as upon 14k. and 16k. gold. Two ounces of C. P. nitric acid, two drops of muriatic acid, will not act upon 18k. but will show a brown stain upon 14k. gold. The gold should be brightened with a file, and the test should be made both at center and cap. For silver, use nitric acid. If it boils a greenish color and a gray stain is left after removing the acid, it is silver; but if the surface is bright on removing acid, it is not silver. If the acid has no effect on the metal except to leave a gray mark, it is silver. If the acid bubbles a grayish color, it is lead.

The experiments of Count Zeppelin in aerial navigation are directed to the development of the cigar-shaped balloon. His design has a carrying capacity of 4,000 pounds, and it can remain afloat for over a week without making any landing. The usual expansion of the gas at the higher altitudes is overcome by compressing a portion of it within suitable reservoirs; the same being returned to the balloon when a descent to a lower level is made. The excellence of the machine consists in the use of an impermeable silk, which absolutely prevents any leakage of the gas. It is propelled by a motor, which is made of an aluminum alloy.

The St. Louis Globe-Democrat states that "one of the surprises of the next decennial census may be the discovery that the national center of population has moved eastward for the first time since the government was formed. The State censuses taken last year indicate that the East is growing more rapidly than the West. In the five years since 1890, Massachusetts gained in population 262,000, or 11·7 per cent. The gain of New Jersey in the same period was 313,000, or 15·7 per cent. Iowa's corresponding gain was 146,000, or 7·6 per cent. Kansas reports a loss since 1890, and Oregon's increase in five years is not quite 8 per cent." In 1790 the center of population lay in Baltimore. In 1890 it lay near Indianapolis, 500 miles to the westward.

Caffeine and theine are the active principles of tea and coffee, tea containing both substances. To the presence of these substances the physiological effects of tea and coffee are due. Now Prof. Fischer and Herr Ach, of Berlin, have succeeded in building up caffeine in their laboratory, and it is suggested that if the elaborate processes represented in the work can be cheapened and simplified, there may be a near future when we shall not be dependent on the plant world for many valuable drugs, of which strychnine, quinine, morphine and other substances are examples; and it is suggested that the tea of the future may be brought to us in the shape of an artificial product of concentrated kind. I very much doubt the correctness of any such idea. An infusion of pure caffeine would not represent or replace an infusion of tea. There would be no aroma, and "the cup that cheers" would sink to the level of a medicinal draught, like most such mixtures, nauseous in kind and by no means of exhilarating nature.—Dr. Andrew Wilson, in Illustrated London News.

[Continued from SUPPLEMENT, No. 1053, page 16830.]

MECHANICAL ROAD CARRIAGES.

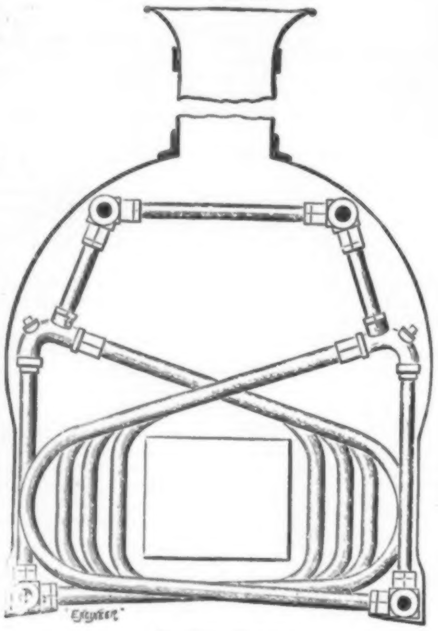
By W. WORBY BEAUMONT, M.Inst.C.E.

[Cantor Lectures before the Society of Arts.*]

LECTURE I.—Continued.

IN 1868 a Dr. Harland, of Scarborough, took out a patent for a steam phaeton, in which the only noticeable point of design is the arrangement of tubes in the front of the vehicle, and forming part also of the coach body framework as an air condenser.

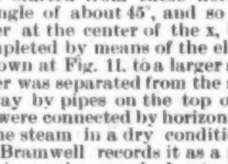
FIG. 10.



DANCE'S BOILER.

The really successful man, however, in this early nineteenth century steam carriage enterprise was Walter Hancock; although some mention must be made of the work done by Sir Charles Dance, who, in 1831, bought and ran some of Gurney's coaches, and according to the evidence given before the Select Committee in 1831, he traveled with these nearly 4,000 miles, between Gloucester and Cheltenham, the carriages running four times a day, from February 21 to June 22 of that year, during which time nearly 3,000 persons were carried. At the end of this time the opposition on the part of the turnpike authorities, or, at all events, with their connivance, made it impossible for Dance to continue the running of his service of coaches, the roads being constantly obstructed by heaps of stones put upon them for that purpose. Dance, however, still hoped that something would be done to open the roads for steam carriages, and he sent one of them to London, where he had it repaired and fitted with a new boiler by Messrs. Mandsley & Field, with whom he took out a joint patent for the new boiler, which is shown in Fig. 10. This, like the boiler of Gurney, was a water tube boiler, and, as mentioned in the description of it by Sir Frederick Bramwell,† had tubes arranged crosswise like a large letter x. At the bottom of the legs of the x were two horizontal tubes extending fore and aft the length of the boiler. Smaller tubes started from these horizontal tubes, partly at an angle of about 45°, and so disposed as to pass each other at the center of the x, beyond which they were completed by means of the elbow and junction pieces, shown at Fig. 11, to a larger scale. Within these the water was separated from the steam, the latter passing away by pipes on the top of the junction pieces, which were connected by horizontal cross tubes, from which the steam in a dry condition was taken. Sir Frederick Bramwell records it as a personal recollection that this carriage worked extremely well, and traveled from London to Reading, a distance of about 45 miles from Hyde Park corner, in 3¼ hours, towing a full omnibus behind it. It would appear that although Gurney's boilers kept the coaches going for several months, as already described, they were not as good as this boiler of Dance and Mandsley's; at all events, Dance thought it necessary to make this new tubulous boiler.

FIG. 11.



DANCE'S TUBE JOINT.

Hancock made a number of carriages of very different forms, one of which is shown by Figs. 12 and 13, and by the large diagram on the wall. It is a rather curious fact that Hancock began by making a steam engine for a road carriage, which consisted of an India rubber bag alternately extended by steam admitted into it, and collapsed during exhaust by the return of the crank which it had on its extension pushed outward. This made a very simple engine, but the material of that which took the place of a cylinder was very soon destroyed. Hancock has described most of his carriages and experiments in the narative he published in 1838, the tone of the introduction to which might be that of an introduction to a similar narrative published by an enthusiastic man of to-day. In fact, a reperusal of this old narrative makes one feel inclined to wonder whether the success he records, the public appreciation he mentions, and the report of the select committee of 1831 which he quotes, could ever have been other than a dream, and to ask, Can all mankind have taken a Rip Van Winkle nap of sixty years to find on waking the same questions uppermost in all men's minds as they are now?

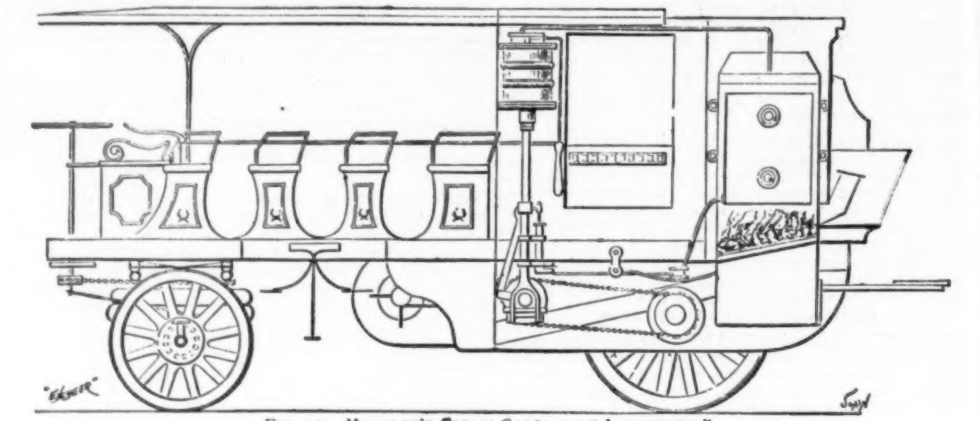
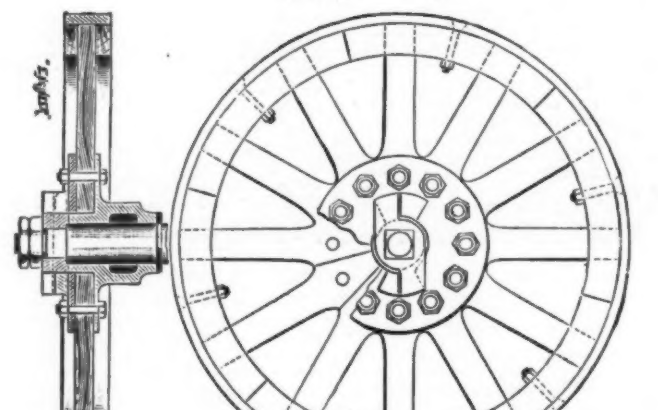


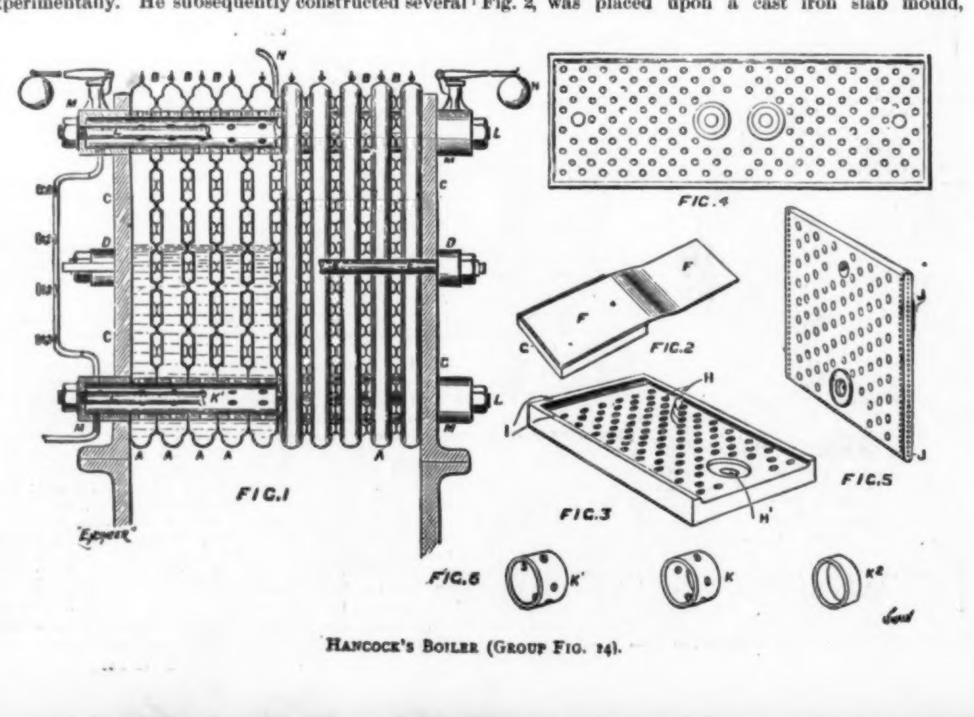
FIG. 12.—HANCOCK'S STEAM CARRIAGE "AUTOMATON."

FIG. 13.



HANCOCK'S CARRIAGE WHEELS AND CLUTCH DRIVER.

Hancock was proud of his achievements, but he thought most of his patent for his boiler. He, like all others who had preceded him, had found this element of the steam carriage most difficult to construct of sufficient capacity and durability. This is shown by a note preceding his introduction to his narrative, which says, "Whatever improvements may result from the mode of generating steam by means of flat chambers, exposing large thin sheets of water to the action of corresponding thin volumes of heated air through flues, formed by alternate chambers placed side by side, the writer claims this as the grand principle feature of his invention." Hancock's first carriage appears to have been a three-wheeled vehicle with a pair of oscillating cylinders on either side of the front wheel. It was not satisfactory, but it ran a great many miles experimentally. He subsequently constructed several coaches and other vehicles of the char-a-banc type, such as that shown in Fig. 12. The engines of both were double cylinder vertical, actuating their own feed pumps, and driving the axle of the main wheels by means of a stout common cable chain running in wheels of equal diameter, of the sprocket order. In each a fan was used in the position shown for promoting combustion in the boiler furnace, the boiler being situated at the rear of the coach as shown, and fed with coke put into a funnel extending from the furnace in such a way that the fire was, to a great extent, self-feeding. Hancock's boiler is shown by the several diagrams of Figs. 1 to 6, group Fig. 14. It consisted of a series of thin or narrow flat iron chambers, the interior surfaces of which were indented or pressed so that when two were placed in contact, these indentations, which took the form of about one third of a hemisphere, came into contact with each other as projections, and left a space between each chamber as shown in Fig. 1, group Fig. 14. The space thus left between each chamber formed the passage through which the products of combustion passed upward to the chimney. In the diagram the chambers are marked A, and between them the spaces are marked B. A series of these chambers were kept together between stout plates, C, and girders, D, through which bolts, E, were passed to keep the whole together. In the construction of the chambers, A, the following process was adopted, as described by Sir Frederick Bramwell. A flat plate of copper or of soft iron, F, Fig. 2, was placed upon a cast iron slab mould,

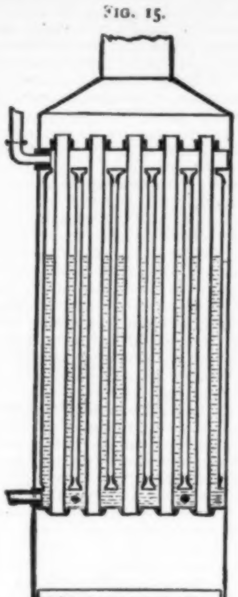


HANCOCK'S BOILER (GROUP FIG. 14).

* From the Journal of the Society of Arts.

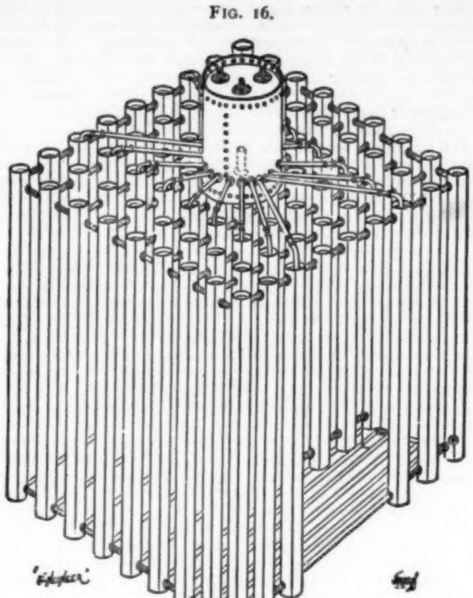
† Brit. Association, 1894. See the Engineer, August 17, 1894. Journal of the Society of Arts, vol. xiii., p. 781.

FIG. 15.



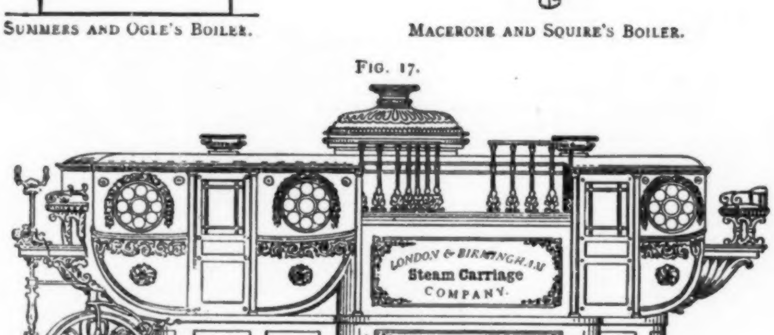
SUMMERS AND OGLE'S BOILER.

FIG. 16.



MACERONE AND SQUIRE'S BOILER.

FIG. 17.



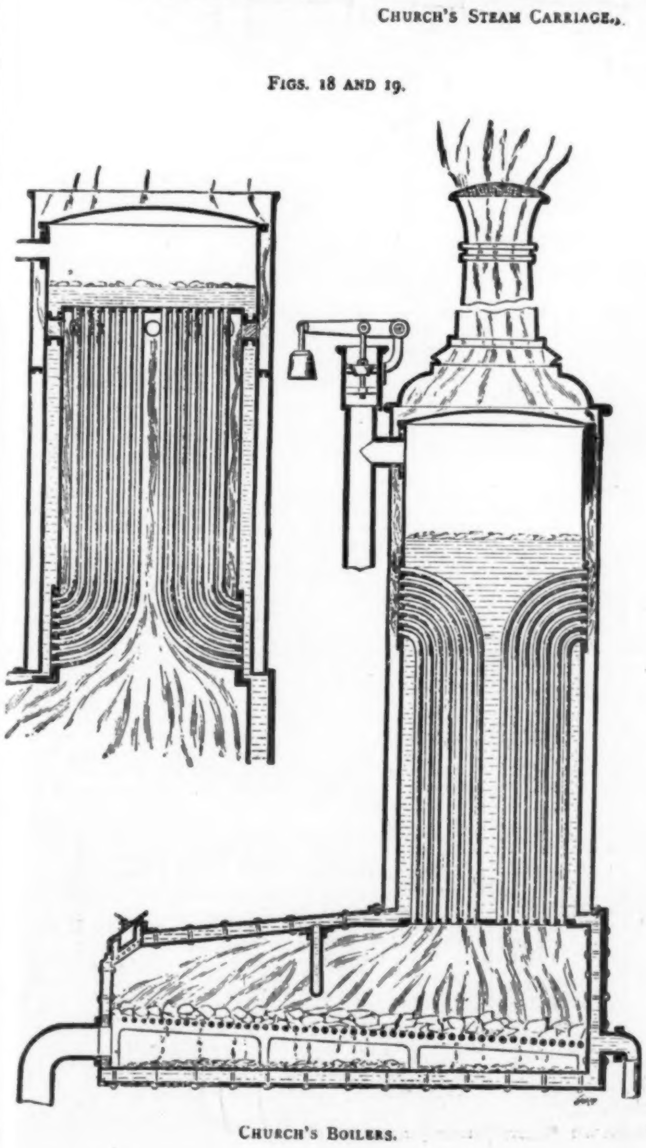
CHURCH'S STEAM CARRIAGE.

shown separately in Fig. 3. It was provided with the indentations, H H, of nearly hemispherical form, and with a larger flat circular indentation, H'. Around the margin was formed a raised rim, I. Nearly one-half of the plate was laid over this mould and, by hammering, was caused to take the forms of the depressions in the mould. Subsequently the other half of the plate was treated in a similar manner, giving the result shown in Fig. 4. The plate was then bent about its middle, so that it took the form when riveted up at the edges shown in Fig 1. The riveted edges not being exposed to the fire, the rivets being confined to the top and the two vertical sides. In Fig. 1 of group Fig. 14 the riveted vertical seams are unintentionally omitted. Each chamber was thus of biscuit bag form, and an alternative mode of construction consisted in riveting in between the sides of the bent up plate a piece of channel iron, shown at J, in Fig. 5. The circular indentations are from 3 to 4 inches in diameter, and were made to receive copper rings or gun metal, K Fig. 6, and a narrower ring, K 2, was placed between the upper part of the chamber. The internal dimension of these rings was the same as that of the holes in the chamber plates, and small radial holes were made in each ring. When the chambers were put together these rings formed tubes, as shown in Fig. 1, the lower one for water circulation and the upper for steam. Through them are passed strong tie bolts, L, nuts on the end of which bore on hollow sockets, M. When these were tightly screwed up, the whole of the chambers were tightly connected and intercommunicating. The steam to the engine was taken off by a pipe, N, and feed water was pumped into one of the lower sockets, M, as shown in section, Fig. 1; and a pipe, connecting the upper and lower sockets, M M, was provided with gage valves, by which the level of the water in the boiler could be ascertained. For making the joints between the several chambers, copper wire rings were used, somewhat flattened by the pressure produced by the nuts of the tie bolts. Thus, Hancock was the first to make tight metallic joints by this simple means. An external casing surrounded the boiler, as shown in Fig. 12, and this was closed, to receive the air from the fan, which was driven off the main engine. The waste steam was blown into the ashpit, and passed up through the fire, so that, except at first starting on a very damp morning, the exhaust steam was invisible and noiseless. The steam from the safety valve also blew off into a silencing box.

The chain pulley on the engine shaft could be disconnected by a clutch, so that the engines could be used to work the feed pump or drive the fan. The road wheels were of wood, shown in Fig. 13. They had very strong, flat spokes, held between two disks on a cast iron nave, both wheels being loose on the ends of the axles. On the outer disks were cast two projections, against which a driving piece with similar projections came into contact.

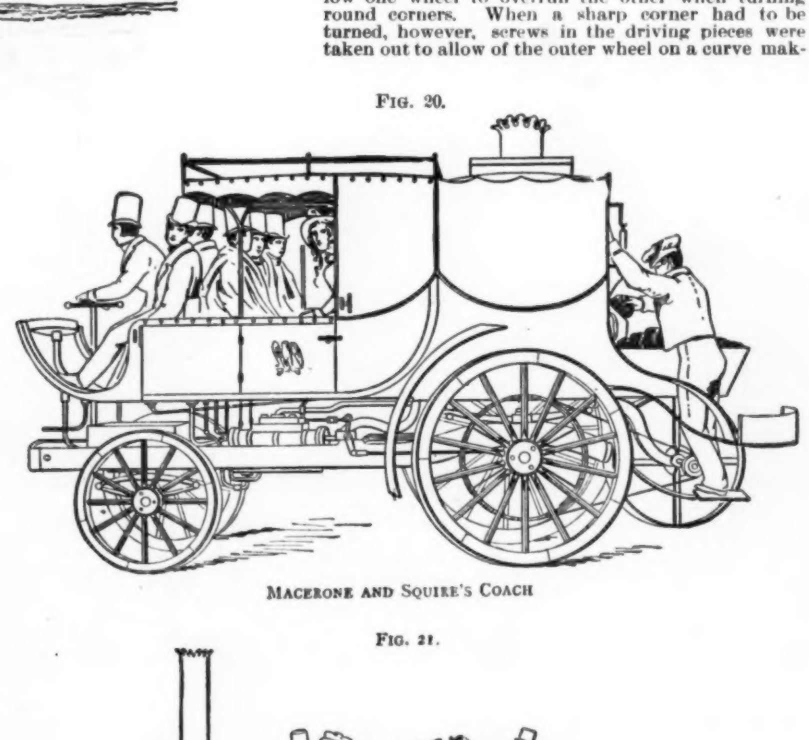
There being only two driving projections on the wheel, the latter was free to move through about 100 degrees as a loose wheel, and this was sufficient to allow one wheel to overrun the other when turning round corners. When a sharp corner had to be turned, however, screws in the driving pieces were taken out to allow of the outer wheel on a curve mak-

FIGS. 18 AND 19.



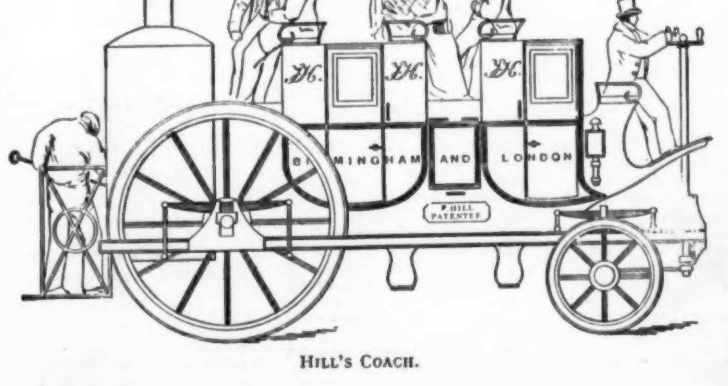
CHURCH'S BOILERS.

FIG. 20.



MACERONE AND SQUIRE'S COACH

FIG. 21.



HILL'S COACH.

ing one or more revolutions while the inner wheel stood still. To avoid this Houldsworth's compensating gear or Jack-in-the-box is now generally used on traction engines, and has been employed since 1862, when it was used by Messrs. Carrett & Marshall, of Leeds, in the passenger carriage they exhibited in the exhibition of that year. A similar device was, however, used by Hill in 1840.* Hancock took out a number of patents, that for his flat chamber boiler, describing a similar formation for a condenser, and in the coach which he named the "Automaton," which was nearly his last, he used a condenser so made, but it does not appear to have been a success.

Fig. 15 shows Summers & Ogle's boiler. The vertical tubes were connected to top and bottom D-shaped tubes, and through them passed the smoke tubes. The tubes were $\frac{1}{16}$ inch thick. Proved to 364 lb.; used at 240 lb.; weight, 85 cwt.; heating surface, including steam space, 245 ft.

Their coach worked well, but was abandoned like the rest. Fig. 16 shows Maceroni & Squire's boiler, which was the same in general character as Summers & Ogle's. Between 1832 and 1835 a Dr. Church, of Birmingham, made the elaborate steam coach shown by Fig. 17. In this carriage Church embodied a great many ingenious ideas. His patent specifications and drawings are documents of great interest, as showing early ideas respecting spring wheels and water tube boilers. The boiler is shown by Fig. 18 (smoke tube), and alternative is shown in Fig. 19 as a water tube boiler.

Fig. 20 shows Maceroni & Squire's coach, and Fig. 21 Hill's coach. To the coaches of Maceroni & Squire and of Hill & Church, further reference will be made.

THE YEAR 1895 IN THE MECHANICAL DEPARTMENTS OF THE RAILROAD INDUSTRY.

In the mechanical departments of our railways, the year just closed has, in many respects, shown a great improvement over the preceding year. For this there are several reasons. The necessity for increased and improved equipment in every line has been largely responsible for the result. The beginning of the present year, owing to the financial depression, witnessed a condition of equipment which upon most roads was never before so unsatisfactory. The number of locomotives in working order was limited by the lack of means for making repairs; the equipment of cars was reduced to the lowest working capacity—and sometimes lower—by the absolute impossibility of making new purchases to take the place of those destroyed by wreck or rendered useless by natural wear and tear; and track work was mostly confined to that which was necessary to insure a comparative degree of safety. As a correlative fact, the shop forces were reduced to the smallest number capable of keeping in running order, and the newest machinery to be seen was such as had been devised by workmen or officials in charge to enable one man to do the work of two.

The improvement in the business situation has not yet become so marked as to more than partially remove the traces of depression, but that improvement and the absolute necessities of the case have been sufficient to secure extensive additions to the motive power and rolling stock equipment, marked alterations in the condition of the roadway and track, and the addition of many new appliances in the shops. The increase in shop forces has not been great, owing chiefly to the fact that the hard times taught that more effective appliances were a better substitute.

The net result has been valuable on account of the fact that the new equipment is, generally speaking, of a much higher type of excellence and more generally conforms to the actual standards of the roads themselves or those imposed by legislative enactment. At the same time the improvements have been in the line leading up to uniform standards for all roads of the country. There have been probably less peculiar types developed and less minor changes from standards of recognized efficiency than if there had been more time for experiment.

Of the approximately 80,000 cars for which orders have been placed during the year, most of them conform closely to the previous standards of the roads ordering them, with the exception suggested—that they are more carefully built as regards detail and are in most instances fitted with the approved forms of safety appliances. Comparatively few cars have been put into service without complete equipment as regards air brakes, automatic couplers and minor appliances, such as handholds, in proper number and position.

In some instances metal has been used in under frames, but the use is not sufficient to weigh in a general statement. The use of metal in trucks seems to have increased to a considerably greater extent, and in many cases the entire truck, including its appendages, brake beams, etc., is specified to be of metal.

The interest of the United States government in the matter of increasing the safety of postal cars has caused the bringing out of a variety of designs for this purpose. Perhaps the most noticeable features in these designs have been the tendency to dispense with end platforms, the general strengthening of the ends of the frame, in some cases by the free use of steel plates, and the rearrangement of the interior to afford greater safety of position to employes. On passenger equipment vestibules have been added in considerable numbers, and the appliances for heating and lighting have shown marked improvement in the nature of the appliances, as well as in the number of cars so equipped.

A conservative estimate of the number of cars to be built the coming year would be 125,000, and it is probably as conservative to predict that nearly, if not quite all, will be equipped with the best type of safety appliances.

On the subject of locomotives there is less to say. A large number of locomotives have been built or placed under order, but with few exceptions they conform to previous standards. One instance of a return to single drivers, and one of a somewhat radical departure from general practice, which, however, is not wholly a novelty, have been fully described by the technical press. Compounds are still in the stage of exploitation and in some cases experimentation, though their efficiency under certain circumstances seems hardly open to question. Counterbalancing has received much attention with few tangible results. Metal for tender frames seems to find increasing favor.

Dependent as it is upon the perfection of mechanical arrangement, it is not out of place to mention not only the record breaking speeds that have been attained upon American as well as English roads, but also the general increase in speed of all classes of trains. As neither of these results could be accomplished without an entire equipment in good condition, the facts are interesting in support of the position we have assumed.

In the matter of roadway, aside from the improvement in the condition of the roadbed as distinguished from the track itself, probably the best examples of change are in the use of heavier rails, the quantities of them used in replacement and new track, and the tendency to the adoption of greater rail lengths. Of the value of rails of increased section in promoting better and safer track there can be no question, and the examples of longer rails seem to indicate the same tendency. Bridges and culverts and the installation of interlocking plants have been given a good share of attention. Tie plates and improved rail joints have not been overlooked, and their use has materially increased.

Methods and appliances in railroad shops have undergone considerable change. New tools, many of them homemade, have been devised to enable a reduced force to accomplish a given amount of work. The necessity of performing the same amount of work in the face of small appropriations and requisitions bluepenciled out of all semblance to their original proportions, has incited greater activity in the brains of the mechanical departments, and better systematized working has resulted. Compressed air, electricity and hydraulic power have made such advances that it is impossible as yet to present a general resumé of the results. The particulars have been quite fully published and the inferences may be drawn individually.

As a whole, then, the indications for the new year, based upon the accomplishments of the last, are most flattering for the mechanical departments. The lesson of the last few years has been in some respects a hard one, but it has been found that a given amount of work can be done at much less expense than was formerly considered necessary, and the result is gratifying to the financial departments. As all are working to one common end, the gratification should be mutual. Let us hope for more of the same kind next year.—The Railway Age and Northwestern Railroader.

* "Steam on Common Roads," p. 138.

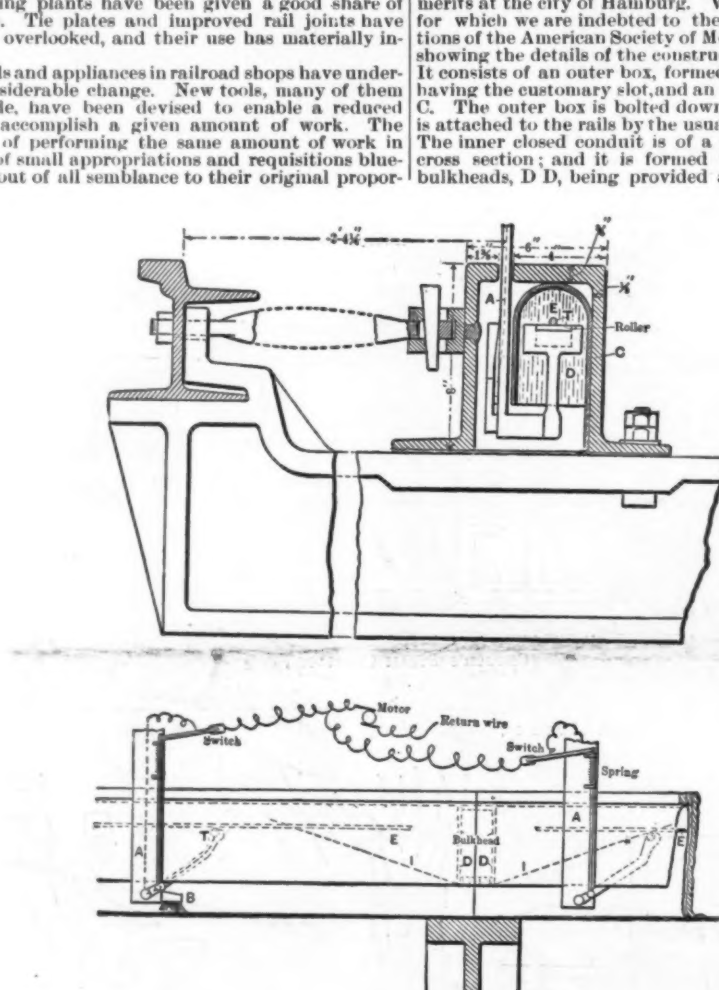
THE AIR CHAMBER TROLLEY CONDUIT.

Unquestionably there is a growing belief among electrical engineers, and particularly among those who are engaged in solving the problems of transportation, that if certain existing obstacles can be overcome the underground trolley will prove to be the cheapest and most satisfactory system. That the system is practical has been proved in two localities in Europe: at Budapesth, Austria-Hungary, and at Blackpool, England, where it has had an extended trial. The experience with the Metropolitan road, in Washington, and the Lenox Avenue road, in New York City, has further established its utility.

The chief objection to the underground trolley is the difficulty experienced, or that would be experienced, in keeping the wire free from dirt, snow, and water, in streets which were incumbered with heavy traffic, where the accumulation of refuse was rapid; or in cities, such as Chicago, where there is liable to be the addition to this refuse of a large accumulation of snow and slush. We say, would be experienced, for the reason, as has been lately pointed out in the technical press, that the existing underground trolley roads are all located on wide streets on which the traffic is comparatively light; and therefore the system cannot be regarded as having as yet been put to the supreme test. A further objection to the present system is found in the heavy cost of construction. The European roads above mentioned cost between $40,000 and $50,000 per mile, ready for the cars; and the cost of the two American roads cannot have fallen much below that figure. In the endeavor to keep the water below the wires the conduit has to be made of such a size that the cost becomes excessive.

The city of Vienna is about to equip several of its existing lines with electricity; and it has decided to use the Lachmann system, otherwise known as the "air chamber trolley conduit," which is claimed to overcome the two objections of cost and operation to which we have referred above. The successful bidder was Herr E. Lachmann.

This will not be the first practical test of this system; Messrs. Siemens & Halske having already proved its merits at the city of Hamburg. We present two cuts, for which we are indebted to the published transactions of the American Society of Mechanical Engineers, showing the details of the construction of the conduit. It consists of an outer box, formed of two Z bars, and having the customary slot, and an inner closed conduit C. The outer box is bolted down upon the ties and is attached to the rails by the usual tie rods, as shown. The inner closed conduit is of a diving bell shape in cross section; and it is formed in varying lengths, bulkheads, D D, being provided at the ends of each section. Each section, it will be seen, thus forms a closed, inverted box. The wire, E, is placed centrally within the upper portion of the box, stretching from end wall to end wall; and where it passes through these walls it is carefully insulated, and between the two walls it is coiled so as to avoid all expansion and contraction strains from the wire. The trolley, T, swings on a hinge at the bottom of the vertical bar, A, and projects up within the inner conduit, contact with the wire being had through a roller at its upper end as shown. To enable the hinged arm of the trolley to pass below the end walls or diaphragms, inclines, I, are provided. These are of course insulated, and their pitch is regulated by the speed at which the car is to be run.



AIR CHAMBER TROLLEY CONDUIT.

As will be seen from the cut two trolleys are provided, and they are so spaced that the leading trolley will have resumed contact with the wire before the trailer has broken its connection. The current is thus rendered continuous.

It is evident that, even if the outer box should be flooded with water, it cannot rise very far within the inner bell shaped conduit, being prevented by the elasticity of the inclosed air. The wire is thus maintained at all times within an inclosed air space which is impenetrable by water.

At the foot of the second trolley, a brush, B, is provided, which sweeps out any accumulations of dirt, dirt holes being provided at intervals to receive the sweepings. The distance apart of the diaphragms is regulated by the grade of the line. On a six per cent. grade, allowing for the fact that under a 12-inch head the water will rise 1½ inches within the inner conduit, the sections are made about twenty-four feet long.

It will be noticed that the outside dimensions of the box are only 6 in. by 8 in. deep; and as many of our American roads are using 9 in. girder rail, it would be possible with this form of conduit to spike it down directly upon the ties.

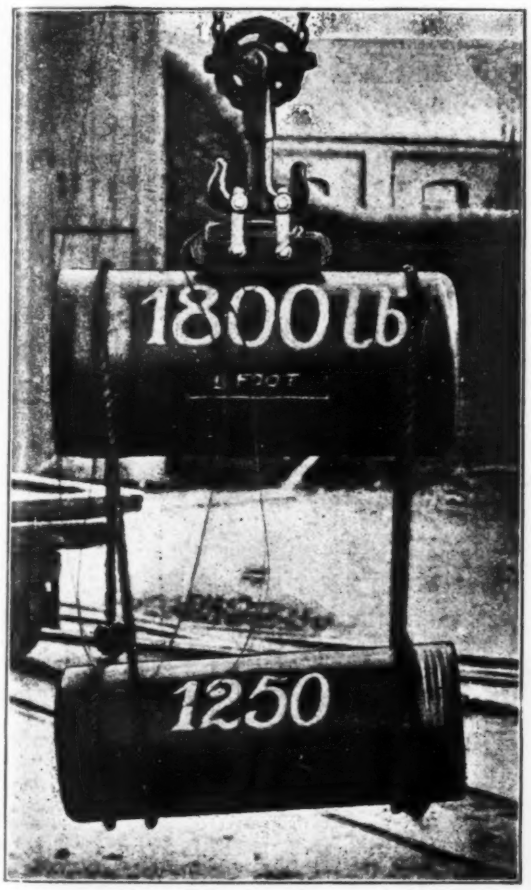
ELECTRO-MAGNETS FOR LIFTING PURPOSES.

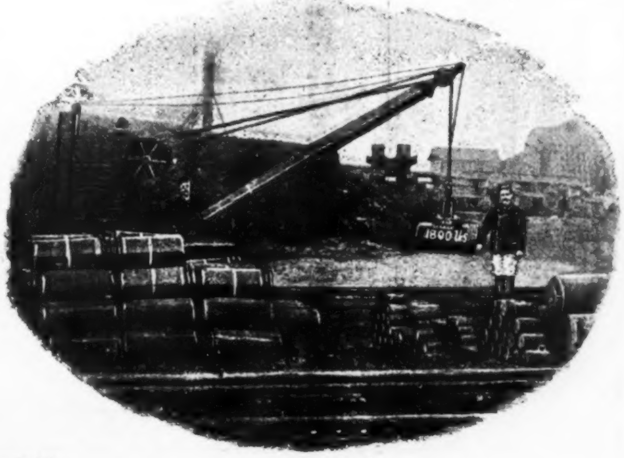
THE following particulars and photographs of some electro-magnetic lifting devices, which have been in everyday use at the Proof Butts, Royal Arsenal, Woolwich, for the last four years, were published by permission of the Inspector-General of Ordnance in the Electrical Review.

The magnets in question were designed by Major H. C. L. Holden, R.A., F.R.S., for the special purpose of lifting the shot that are used for proving guns and for ballistic experiments generally. These shot, it will be seen from the photographs, are of special form, having a flat instead of a pointed head, in order that their motion may be arrested as quickly as possible in the sand of the butt into which they are fired. The shot weigh from 1,800 lb., the weight of the projectile fired from the 110-ton gun, downward to the smallest bores; they are piled one upon another in the stores, and it used to be somewhat laborious work moving them when required, not only on account of their weight, but also on account of the difficulty of getting slings round them. The introduction of the electro-magnet in the place of the slings has made the task easy, and one which is, moreover, quickly performed. The figures require but little explanation, as they show clearly the construction and method of employment.

The body or core of the magnet is ∩-shaped and in one forging. The winding is mechanically protected by stout brass flanges and is covered with thick brass strip. The ends of the winding are led to duplicate terminals. Duplication wires, to prevent accidents in the case of the wire fouling and breaking, being taken over pulleys to the switch box on the counterweight at the back of the crane.

A single pole switch is placed in this box and is used, in conjunction with a water resistance, to shunt the extra current produced on breaking the circuit, to close or open the circuit. The current varies from 3 to 4 amperes at 20 to 30 volts. The maximum weight that can be lifted has not been ascertained exactly, but it exceeds 3,600 lb. as two 1,800 lb. shot can be lifted, one slung below the other in the manner shown in the photograph of an 1,800 lb., and 1,250 lb. shot being thus lifted. The shot are of hard cast iron or cast steel, their surface is rough and thickly covered with paint. The weight of the electro-magnet complete is about 45 lb.

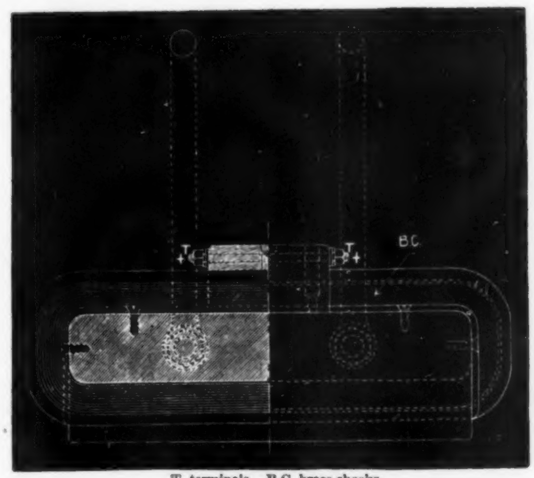




Bronze shackles.

Winding 230 turns 0·064 in. wire.

Struck to 8·125 in. radius. Sheet brass covering.



T, terminals. B C, brass cheeks.

ELECTRO-MAGNETS FOR LIFTING PURPOSES.

MAGNETIC INFLUENCE OF THE PLANETS.

By ARTHUR SCHUSTER, in Nature.

AN attempt to discover a direct magnetic influence emanating from the planets is described in "Magnetismus der Planeten," by Ernst Leyst. For this purpose the author makes use of the observations taken at St. Petersburg and Pawlowsk during the years 1873-1889, and calculates the average magnetic declination for the days at which the planets are at their greatest and least distance from the earth; also for those days at which the planets are at their greatest eastern and western elongation. The numbers so obtained show certain regularities, which are considered sufficiently marked to indicate a true effect of the planetary configurations. According to the tables given, the declination is increased by 0′·2 of arc when Venus is nearest, and is diminished by 0′·32 when it is furthest away. Mercury acts in the opposite direction, diminishing the declination by 0′·29 when it is nearest and increasing it by 0′·20 when it is furthest. The backbone of an inquiry like this ought necessarily to be found in a careful discussion as to how far an accidental combination of figures could account for the apparent effect. The magnetic declination is subject to so many changes which to us seem accidental, that if we take a certain number out of the whole series of daily averages, they must necessarily show deviations. The whole question then turns on the discussion whether the effects found by Mr. Leyst are sufficiently large and regular to be considered as real. This part of the subject is, unfortunately, treated in an insufficient manner, and, for this reason, the author has not in my opinion made out his case.

We may, however, from Mr. Leyst's numbers, draw the conclusion that even if the effect is a real one, it cannot, as the author considers, be due to an ordinary magnetic force depending in its magnitude on the distance of the planets. Within a few days of conjunction that distance does not vary appreciably, and Mr. Leyst should therefore get more trustworthy results by taking account not only of the days of conjunction but of a group of days immediately surrounding the configurations. The necessary data are supplied by Mr. Leyst, and it appears that, taking Mercury, for instance, the diminution of declination is reduced from 0′·29 to 0′·20 when the preceding and following days are taken into account; while when five days altogether are considered, there is a further reduction of the effect to 0′·15, and when a month is taken, in the middle of which the inferior conjunction lies, there is only a deviation of 0′·08 from the average declination. The other planets show the same fact. The average effect of all the planets amounts to 0′·33, which is reduced to 0′·26, 0′·17, and 0′·08 when the three days, five days, and the month nearest to conjunction are taken into calculation. If the effect is a real one, it must be due to some other cause than an ordinary magnetic action, for it practically vanishes two days before or after conjunctions, when there is very little change in the relative positions of sun, planet, and earth. Mr. Leyst himself draws attention to the rapid diminution of the supposed planetary influence within a few days of conjunction, but considers it to be an argument in favor of his view.

The amplitude of the diurnal variation is discussed; and here, of course, also a planetary effect is found, which, curiously enough, is greater for Neptune and Uranus than for Venus and Mercury. The "probable error" of the result is considered, and is calculated to exceed the supposed effect in the case of Mercury, Mars and Saturn, and to amount to about two-thirds of the effect in the case of Venus, Uranus and Neptune. The author draws the conclusion that the planetary influence is "certain" for the three latter planets and Jupiter.

It is hardly necessary to follow the author further in the complicated results he deduces, by separating what he calls the "primary" and "secondary" extremes, the primary and secondary amplitudes, and the irregular and periodic part of the diurnal variation; the primary and secondary quantities being affected in opposite directions by the mischievous Mercury. In fairness to the author, it must be stated that some of the effects of that planet are found to be in the same direction when the whole period of fifty synodic revolutions is divided into two, which are separately considered. Nevertheless, a careful perusal of Mr. Leyst's work leads to the conclusions that he has not proved his case. Among the many improbabilities of magnetic influences which are hanging over us, that of a planetary effect may for the present be set aside.

ON THE RAYS OF ROENTGEN.

By Prof. E. SALVIONI.*

I HAVE the pleasure of briefly communicating to the academy the results of some studies which I have undertaken on the rays of Roentgen.

The theoretical portion of these studies had for its object to examine if Roentgen's agency could be considered as a form of light in the sense that this agent consists in vibrations of the ether. It is known that Roentgen, in his memoir, emphasizes the probability that we have to do with longitudinal waves of the ether. Now the totality of the facts established by him, and especially the fact that the agent is propagated with the same rapidity in different transparent media, and that a substance is so much the more transparent to these rays the smaller is its density, have caused a doubt to spring up in my mind that the power may be due to highly subtile matter † projected from the Crookes tube, a matter to which bodies are permeable so much the more as they are less compact. Bodies will be traversed by the subtile particles of this matter more or less easily as a net more or less close would be by a discharge of small shot. I communicated this idea in private conversation, and have since found that, without my knowledge, it had appeared in a correspondence in a daily paper.

From a very summary account of a lecture delivered at Pisa by Prof. Garbasso, I learned that this idea is shared by him and Battelli, and is confirmed by their researches. But what is the subtile matter? It must either be common matter projected from the Crookes tube or imponderable matter, such as the cosmic ether.

Let us pass to that portion of my studies which renders the application of Roentgen's discovery more easy. I submit to the academy photographs taken by Roentgen's method.

The photographs of several metals (magnesium, aluminum, iron, lead, zinc, copper, palladium, silver, gold, platinum) confirm the relation between transparency and density discovered by Roentgen.

I give a photograph of my hand showing the bones. The cartilages are not transparent, but the spongy parts of the joints are more transparent. Two of the photographs show a frog paralyzed with curare taken with different times of exposure. One of these proofs, besides the bones, shows the two lungs; in the other there are seen, besides the lungs, also the heart and another viscus.

I then turned my attention to the eye. Roentgen has found that bodies fluorescent by common light fluoresce also in his rays. I instituted experiments on a retina taken from a living animal—a rabbit. The observations made with the living retina showed that the retina is somewhat fluorescent to the light emanating directly from a Crookes tube, but with the Roentgen's rays there was no appearance of fluorescence. I studied in the sequel by the photographic method the transparence of Roentgen's rays in the dioptric apparatus of

* A communication made to the Medico-chirurgical Academy of Perugia, on February 6, 1896. In the Electrical Review.

† Radiant matter.

the eye, and I obtained the result that the totality of the various media which constitute it intercept the rays of Roentgen almost like a small plate of common glass, of the size of one millimeter, and hence very little transparent. It seemed possible to see in an indirect manner through wood, aluminum, flesh, etc., by an indirect method transforming Roentgen's rays into common luminous rays before they arrive at the eye. I have constructed a simple apparatus by means of which I can see distinctly the outline of objects inclosed within boxes of card, aluminum, etc. This cryptoscope, which I have the pleasure of submitting to the academy, is a small tube of cardboard of about 8 centimeters in height. Its bottom is completely closed with black cardboard on which is laid a stratum of fish glue and calcium sulphide, a substance which I have found very phosphorescent in Roentgen's rays. Within the tube of cardboard at the other extremity to which the eye is applied is fixed a lens which enables us to see clearly the phosphorescent cardboard, keeping the eye in a state of repose. With this cryptoscope applied to the eye, it is possible to see, even in a lighted space, the form and position of metallic bodies inclosed within boxes of cardboard, of wood, of aluminum, and within flesh.

This apparatus, when suitably improved, will be found convenient for surgical and medical applications, not less in the scientific study of phenomena substituting direct vision for photography. For calcium sulphide there may be substituted with advantage platinum and barium cyanide.

If your granite has rust on from rubbing, grease or any stain, wet thoroughly with water; then mix plaster of Paris with muriatic acid about the consistency of thick paste, and apply it on parts about one-fourth of an inch thick, leaving it on for fifteen minutes; after taking off wash parts clean; repeat application if necessary. This must be done in the shade, and if the piece to be cleaned is in the cemetery, take a cloudy day to do the work. If the sun shines on it discoloration sets in. Always use care in washing off the acid.—Stone.

THE POLARIZING PHOTO-CHRONOGRAPH APPLIED TO THE MEASUREMENT OF THE VELOCITY OF PROJECTILES.*

This new instrument for the reliable measurement of very minute intervals of time was developed in some preliminary experiments at the United States Artillery School, Fortress Monroe, Va., in measuring the velocity of projectiles from the new 3·2 inch B. L. field rifle adopted by the army.

In the course of these experiments, which were necessarily limited to two weeks' time, observations were taken at intervals as small as 5 feet, and as many as ten consecutive observations at 5 foot intervals, beginning at the muzzle of the gun and extending to 45 feet distance, were easily obtained from a single shot. This instrument being admirably adapted for recording the passage of the projectile at a number of points of its trajectory, it was made an object to study the law of variation of the velocity of a projectile near the muzzle of a gun. From measurements on the negatives it is clearly evident from each that the velocity actually increases after leaving the gun, a fact which has long been suspected, but which, so far as we know, has not previously been demonstrated experimentally.

The particular form of transmitter used in these experiments depends for its action upon the use of polarized light. A sensitive photographic plate is made to rotate at a known speed in a light-tight box, and light is admitted to the plate through a narrow slit by means of a "massless" shutter, as the inventor terms it. Any material shutter would possess a certain amount of inertia, and would not admit of a practical result. By the use of a polarizer the light is admitted or shut off without the movement of any material thing.

As is well known, the most efficient polariscope consists of a pair of Nicol prisms. When the prisms are "crossed," the light is totally extinguished, as though the beam had been interrupted by an opaque body. By turning the analyzer ever so little from the "crossed" position, light will pass through it, and its intensity increases until the planes of the prisms are parallel, when it again diminishes, and if one of the prisms is rotated, there will be darkness twice every revolution.

To accomplish the end that is obtained by rotating the analyzer without actually doing so, a transparent medium which can rotate the plane of polarization is placed between the polarizer and analyzer, and made subject to the control of an electric current. The medium used in these experiments was liquid carbon bisulphide, contained in a glass tube with plane glass ends. This was selected because it is very clear and colorless and possesses the necessary rotary property to a considerable extent when situated in a magnetic field of force, the rotary power being in proportion to the intensity of the magnetic fie'd.

To produce a magnetic field in the carbon bisulphide a coil of wire is wound around the glass tube, and an electric current passes through the coil. The prisms being crossed, so that no light emerges from the analyzer, a current is sent through the coil on the tube, causing the rotation of the plane of polarization.

This is equivalent to rotating the polarizer; hence a light now emerges from the analyzer. When the current is broken the medium loses its rotary power and there is again complete darkness. This arrangement makes an effectual shutter for the beam without moving any mass of matter.

A view of the laboratory apparatus is shown in Fig. 1. Fig. 2 shows diagrammatically a complete arrangement of the electrical circuits and apparatus, and Fig. 3 shows the apparatus on the proving ground. Corresponding letters represent like parts in the figures.

The arc lamps, L and L', are used as sources of light. P is the polarizer; T, the transmitter tube containing carbon bisulphide and wound with magnet wire; A is the analyzer, in front of which is a lens to condense a beam of light upon the camera, C. The motor, M, revolves the sensitive plate in the camera.

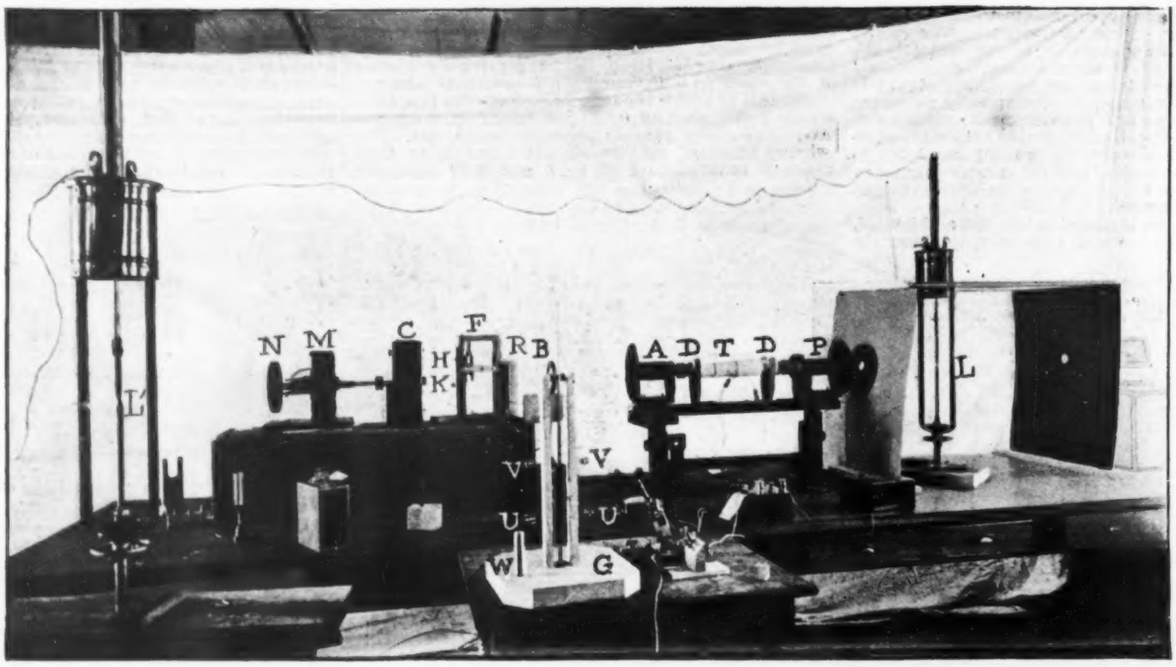


Fig. 1.—ARRANGEMENT OF LABORATORY APPARATUS.

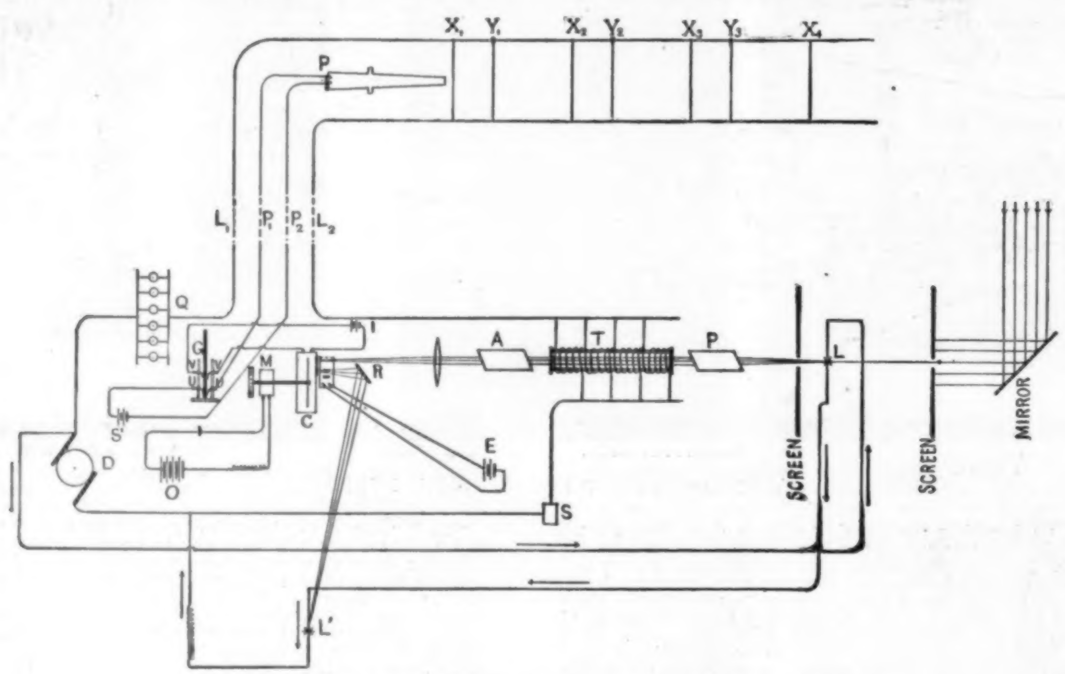


Fig. 2.—COMPLETE ARRANGEMENT OF ELECTRICAL CIRCUITS.

* An abstract from an interesting paper by Dr. Albert C. Crehore, Assistant Professor of Physics at Dartmouth College, and Dr. George O. Squier, First Lieutenant, Instructor United States Artillery School. For a full account of these experiments see Journal of the United States Artillery, July, 1895.—Fortress Monroe Press.

The speed of the plate is obtained at the moment of firing by the shadow of one prong of a tuning fork cast by a beam from the lamp, L′, reflected from a mirror, R, upon the sensitive plate, the tuning fork being run electrically by the cells, E. At X', X^2, X^3, etc., placed at regular intervals from the gun, are wire screens which are cut one after the other by the projectile.

At Y', Y^2, Y^3, etc., are placed devices for mechanically restoring the current. Before firing, the current passes only through the screen, X', because of an insulating plug placed between the jaws of the device which interrupts the connections between X', X^2, X^3, etc. When the projectile strikes a wire attached to this insulating plug, the plug is pulled out and the jaws spring together, thus establishing the circuit through X^2.

The receiver is a photographic means of recording the intermittent beam of light through the analyzer, and consists of a camera containing a sensitized plate, which is shown in position ready for use at C (Fig. 1). Detailed views of the camera are shown in Figs. 4 and 5. It is made of wood, in the shape of a rectangular box, the interior dimensions being 10 inches high by 10 inches wide by 2·5 inches deep. Fig. 4 represents the front view of the camera box, A, with the cover, B, removed, showing the small auxiliary dark chamber, C, which contains the electromagnetic device, D, with armature, E, attached to the brass spring, F, for releasing the camera slide, G. This slide is shown in the photograph, withdrawn from the grooves in which it normally slides by passing it through the opening at the top after removing the cover, H. The narrow horizontal slit through which light is admitted to the photographic plate is shown at I.

When the camera slide is in position, the nail at K rests upon the top of the brass spring, F, and the upper edge, L, of the lower screen of the slide covers the slit, I. When the current passes through the electromagnets by the binding posts, M, the armature is drawn and the slide released. The slit is exposed only while the opening in the camera slide is passing by.

When the camera slide comes to rest, the upper screen, G, covers the slit and it remains so covered. The upper screen, G, is capable of adjustment along the brass rods of the slide, and the opening between the upper and lower screen of the camera slide is thus adjustable, and the time of exposure of the slit under control.

The wires shown at O are for the purpose of producing on the plate reference circles by casting their shadows. The entire back of the camera is removable, and its outside face is shown at P. Through the cen-

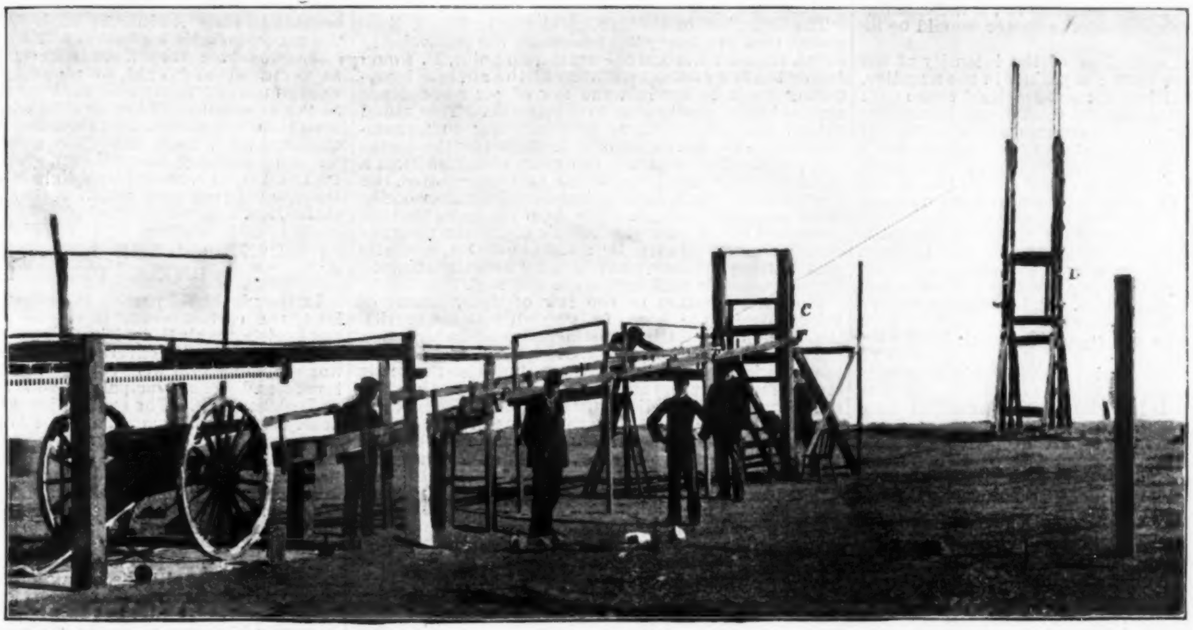


FIG. 3.—EXPERIMENTAL APPARATUS ON THE PROVING GROUND.

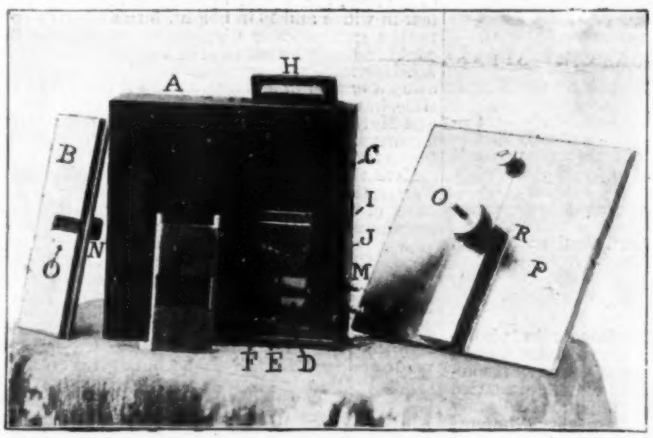


FIG. 4.—CAMERA—FRONT VIEW.

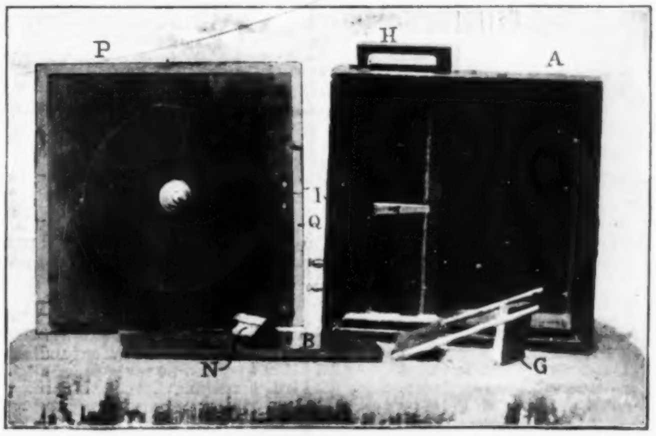


FIG. 5.—CAMERA—INTERIOR VIEW.

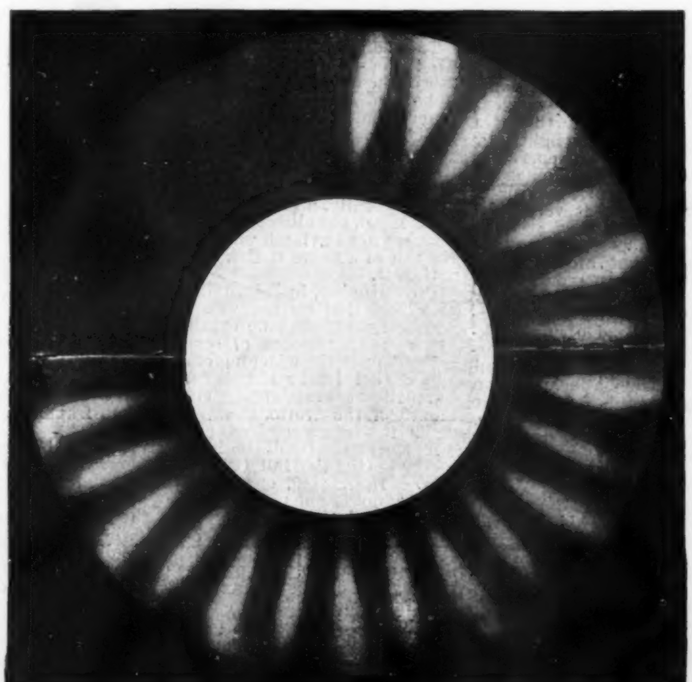


FIG. 6.—CHRONOGRAPH RECORD OF ALTERNATING ARC LIGHT.

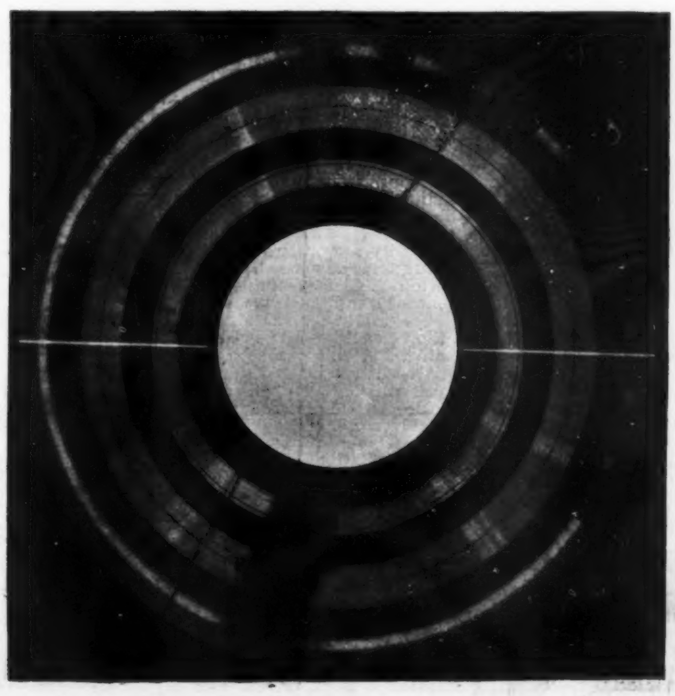


FIG. 7.—PROJECTILE CHRONOGRAPH RECORD—10 POINTS.

ter of the back a horizontal shaft, Q, passes, which revolves in the bearing, R.

Fig. 4 shows the inside of the camera. The inner end of the shaft is shown, Q, and the photographic plate, S, is mounted on this shaft. An ordinary adjustable lens shown in Fig. 2 was used to condense the light which came through the analyzer upon the slit.

The electrical tuning fork is shown at F (Fig. 1). Four storage cells were used to energize the motor, and greater uniformity in speed was obtained by placing a heavy iron-toothed gear wheel as a flywheel on the motor shaft, as shown at N (Fig. 1). This wheel also served another purpose in offering a convenient and ready means of determining the proper speed of rotation for a given setting of the camera slide. The wheel contained 56 teeth, and by simply holding on its periphery the edge of a card, with the motor running at an unknown speed, the corresponding note would be given out, and when this was compared with a tuning fork in the other hand of the observer, it indicated at once whether the speed of the motor should be increased or diminished.

Inasmuch as the variations of the intensity of the constant current are shown so plainly in the negative, an ordinary alternating current arc light taken with the "receiver" is shown in Fig. 6. This shows that the arc goes completely out and appears again at regular intervals. It is noticeable that every other light spot is similar, but consecutive ones are different. The cause of this was a magnet held near the arc, so that it was drawn out to the left when the current went one way and to the right when it went the other.

The velocity of the projectile is obtained from the measurement of three quantities, the distance between screens, ω the angular velocity of the plate, and θ the angle through which the plate revolves while the projectile passes between screens. This gives the expressions for the velocity $v = \omega \frac{s}{\theta}$. The angle θ upon the plate can be measured with considerable accuracy. In an average case with a distance of 40 feet between screens the angle θ is 108° 0969 with a probable error from nine measurements of 0 0074 or an error of one part in 14,630. The angular velocity ω can with proper instruments be obtained with great accuracy.

In Fig. 7 is shown a chronograph negative which shows a record of the projectile at five foot intervals from the muzzle to a distance of 45 feet. Table I gives the relation between the several quantities, and the velocities found by considering the muzzle screen to be the first screen are shown in Table II.

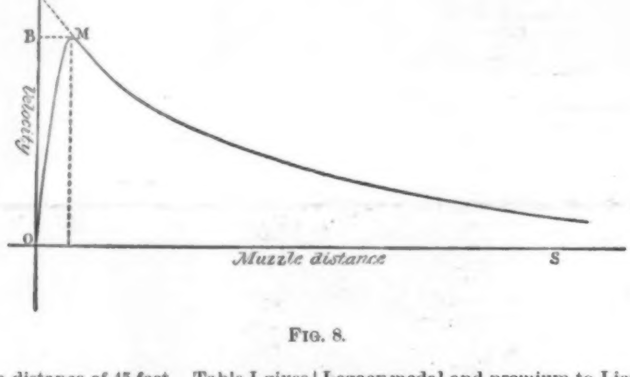


FIG. 8.

TABLE I.

s	θ
5	13° 49' ·29
10	27° 19' 29
15	40° 53' 79
20	54° 36' ·00
25	68° 24' ·83
30	82° 28' ·25
40	110° 10' 46
45	123° 50' ·88

TABLE II.

s	v
2·5	1599·4
5·0	1610·8
7·5	1621·7
10 0	1619·5
12 5	1615·6
15 0	1608·3
20·0	1605·3
22·5	1606·5

TABLE III.

s	v
2·5	1599 4
5 0	1637·5
7·5	1633·0
10·0	1626·8
12·5	1619·7
15 0	1610·5
20·0	1606 0
22 5	1607·3

Table II, graphically exhibited, shows that the velocity suddenly increases within a distance of 6 or 8 feet from the muzzle of the gun, and beyond that point gradually diminishes. Every negative obtained shows an increase at the beginning of the trajectory. Since the velocity does increase for some distance from the muzzle, the average as measured from the muzzle screen must be less than if the point from which we measure were the maximum point. The velocities, calculated from the same readings as before, and taking the five foot screen as the first instead of the muzzle screen, are given in Table III.

The foregoing experiments justify one or two conclusions: This chronograph, as thus far developed, has clearly demonstrated its important field of usefulness for the accurate measurement of small intervals of time. The record made by a break in the current due to the passage of the projectile is sharper and more defined than we had anticipated, and this permits of an accuracy in reading the record even beyond that attainable in measuring the intervals between screens on the proving ground. A future working instrument designed upon this fundamental principle is capable of endless modification, and an instrument properly designed would be as simple in its operation as any of the well known chronographs now in use. The whole is manipulated by a single switch, which fires the gun and obtains the record.

The adaptability of this instrument for obtaining observations at any number of points of the same trajectory and the nearness which these points may have to each other make it admirably suited to the study of the law of change of velocity near the muzzle of the gun, and also to the systematic study of the law of the resistance of the air to projectiles of various forms; a problem which, since the advent of the modern high power gun with its realm of velocities unthought of in the classic experiments of Bashforth, is at present of paramount importance to the science of exterior ballistics.

The principal ballistic result obtained from these experiments may be said to be the locating of a maximum point in the velocity curve outside of the gun. This maximum point is, in the case of the gun and conditions of loading described, at 6 or 7 feet from the muzzle of the gun—certainly more than 5 feet and less than 10—or about 25 calibers in front of the muzzle. The increase in velocity from the muzzle to the maximum point is large, more than 40 foot seconds. The muzzle velocity being about 1,600 feet, this increase is about 2·5 per cent. of the whole.

The decrease in velocity beyond the maximum point is comparatively gradual, obeying the true law of the resistance of the air, so that the projectile must travel about a hundred feet before the velocity is reduced to that which it actually had at the muzzle.

This maximum point introduces an error in the present method of obtaining muzzle velocities, in which the velocity is mea sured at a distance of 100 to 200 feet and reduced back to the muzzle by formulas.

The direction of this error is shown in Fig. 8. Supposing that the heavy line represents the true velocity curve, the part beyond the maximum point, M, would follow the law of the resistance of the air, and by reducing back by formula the law of air resistance is assumed to be continuous to the muzzle. This would extend the velocity curve corresponding to formula back to the maximum point, as indicated by the dotted lines, to A. The diagram measures velocities from a horizontal axis much below the axis represented, the increment of velocity above the actual muzzle velocity alone being represented. The diagram shows that the computed velocity for the muzzle is greater than the actual muzzle velocity by an amount O A, and also greater than the maximum velocity actually attained by the projectile at M by the amount A B.

The determination of the law of development of velocity inside the bore of a gun without the mutilation of a gun would be a distinct advance in ballistics. Upon the data such curves would furnish, rest not only the questions of gun construction, but also the ready study of new powders and their adaptability to existing ordnance. A few preliminary experiments were tried with a view of determining the value of this instrument for the measurement of velocities inside the bore, but any mention of them is withheld until further experiments can be made.

The Franklin Institute has awarded the John Scott Legacy medal and premium to Lieut. Squier and Prof. Crehore for this apparatus.

BLACK LIGHT.*

THE recent publication of experiments in photography by cathodic rays decides me to make known some researches, although they are as yet very incomplete, that I have been pursuing for the last two years upon photographing through opaque bodies by ordinary light. The two subjects are very different. The results alone present some analogies. The following experiments prove that ordinary light, or at least certain of its radiations, traverse the opaquest bodies without difficulty. Opacity is a phenomenon that exists only for an eye like ours, which, were it a little differently constructed, might be able to see through a wall. Into an ordinary positive photographic frame let us introduce a sensitized plate, and, above it, any photographic negative whatever, and in intimate contact with the latter, an iron plate that entirely covers the front face of the frame. Let us expose the glass thus concealed by the metallic plate to the light of a kerosene lamp for about three hours. An energetic and greatly prolonged development, carried on as far as to the entire blackening of the sensitized plate, will give an image of the negative that is very pale, but very distinct by transmitted light.

It suffices to slightly modify the preceding experiment in order to obtain images that are almost as strong as if no obstacle had been interposed between the light and the sensitized glass. Without in any way changing the preceding arrangement, let us place behind the sensitized glass a plate of lead of any thickness and turn its edges down so that they shall partially cover the sides of the iron plate. The sensitized glass plate and the negative will thus be inclosed in a sort of metallic box whose front part is formed of the iron plate, and the back and sides, of the lead plate. After three hours' exposure to the light of kerosene, as before, we shall obtain a strong image through development.

What is the role performed by the plate of lead in this second experiment? Provisionally, I suppose that the contact of two different metals would give rise to very feeble thermoelectric currents whose action would be added to that of the luminous radiations that had traversed the iron plate.

I hope that before long I shall be able to determine the role of the different factors that may enter into play in order to produce the preceding results. I hope, too, that I shall find it possible to determine the properties of light after its passage through opaque bodies. The action that might be exerted by heat, or the action of the light stored up upon negatives, has already been entirely eliminated in my experiments.

The light of the sun gives the same results as that of kerosene, and does not appear to act much more rapidly.

Cardboard and metals, iron and copper especially, are easily traversed by light. Such passage of light through the opaquest bodies is only a question of time.

If the preceding experiments be repeated with a camera, that is to say, if a metallic plate be placed in front of the sensitized glass, and, consequently, between the latter and the object to be photographed, we obtain in two hours in the sun an intense blackening upon development, this proving the passage of the light through the opaque plate; but we obtain images only very exceptionally and under conditions that I have not yet been able to determine.

I have given the radiations of unknown nature that pass through opaque bodies the name of "black light," because of their invisibility to the eye. Considering the variations existing between the number of vibrations producing the different forms of energy, such as electricity and light, we may suppose that there exist numerous intermedia that correspond to forces as yet unknown. These must be connected, through insensible transitions, with the forces that we are acquainted with. The possible forms of energy, although we know but very few of them as yet, must be infinite in number. Perhaps black light represents one of these new forces with which we are unacquainted.—G. Le Bon.

* Note presented to the French Academy of Sciences, January 27, 1896, by Prof. D'Arsonval in the name of Gustave Le Bon.

DESCENT OF THE ABYSS OF GAPING GHYLL, ENGLAND.

IN the northwest part of the county of York, England, the carboniferous limestone formation, which has Ingleborough Hill (altitude 2,375 feet) as a center, is perforated with caverns, and especially with innumerable natural wells called "pot holes" or "swallow holes." The principal cavern is that of Clapham or Ingleborough. The exploration of it was finished nearly sixty years ago, and Mr. Farrer gave a very accurate plan of it as long ago as 1849. It opens to the south of Ingleborough Hill at a mile and a quarter north of the pretty town of Clapham, in the immense and picturesque domain of Mr. J. Farrer (Ingleborough Hall), who courteously gives visitors free access to it. Mr. Harrison, the guide, is very agreeable and intelligent.

The grotto has two openings. One of them, the lower, at 825 feet altitude, allows of the passage of a large stream that immediately forms Clapham Beck. It is called Beck Head, and it is impossible to enter it beyond a few steps, since the rock comes flush with the water. It is a joint widened between two strata. At 98 feet to the left and 23 feet higher (at an altitude of 850 feet), the second opening, a surbased porch 56 feet in width and 16 in height, forms the true entrance to the grotto. The distance to which the interior could formerly be penetrated was 230 feet, but in 1837 Mr. Harrison, one of Mr. Farrer's gardeners, broke away a barrier of stalagmite, and it then became possible, in two years of researches made by Messrs. James and Matthew Farrer and Lord Eldon, to push through a gallery, having the general form of a semicircle, as far as to 702 yards from the entrance.

Here the noise of a stream was heard. Mr. James Farrer, the uncle of the present owner, even reached a sheet of water, which he explored by swimming, having a candle fixed to his hat and a rope around his waist, but he was unable to advance far. Later on, Mr. J. Birkbeck met with no better success.

A series of fissures running northwest by southeast intersects the main gallery and has been named the "Gothic Arcades." These fissures are transverse diaclases, now widened to an elliptical form, and now very narrow, that ascend to quite a height in the vault and perform the service of natural drains.

Mr. Phillips has found that the current of water passed in old times through the principal gallery, which it perforated at the expense of the horizontal strata and their joints, and that the vertical diaclases have permitted of the filtration of the water that has deposited the concretions. The latter are very abundant and quite handsome. In places, they rival the stalactites of Mitchelstown, in Ireland, but in nowise those of the large grottoes of the Continent.

The section of the cavern is of medium size. Nowhere does the vault descend to less than within four feet of the floor. At one section only has blasting had to be resorted to. Its greatest elevation reaches but 60 feet, and this is in the last chamber, called "Giant's Hall," which is scarcely 30 yards in diameter.

At the period of the great storms at Ingleborough, the water, filling all the crevices of the hill, escaped therefrom through the least fissures at its base. Then, very naturally, a furious stream pours not only out of Beck Head, but also out of the grotto's upper opening, which, after having been the primitive exit, still plays the role of a waste outlet, as at the Rjeka, the Bonnette, etc.

Prof. Hughes, in July, 1872, witnessed a spectacle of this kind that he has well described, in explaining what influence may be exerted by such volumes of liquid, at a pressure of several atmospheres under ground, upon the widening of caverns and the destruction of their least resistant walls. He saw enormous quantities of sand and pebbles expelled from the mouth of the grotto, along with large fragments of stalactites torn away by the cataclysm.

At the extremity of the last Gothic arch that gave access to Giant's Hall (which has been closed since 1872) I recognized, on the 31st of July, 1895, the existence, not of one passage, but of three passages ending at running water. These are the three conduits, very close together, through which the storms cause the subterranean streams to ascend, all charged with sand and pebbles. All of these passages descend quite rapidly and can be followed only through troublesome crawling, and the level of the water, which was very high on the day of my visit, prevented me from renewing the old investigations of Messrs. Farrer and Birkbeck. The rocky stratum of the ceiling was almost completely "bathing" and allowed me no longer the place necessary for my head. The circulation must be effected between joints that are not very open, up as well as down the passages, and I am led to believe

that any ulterior penetration is, the greater part of the time, impossible in either direction. A final experiment, after a long drought, will be necessary to decide the question, however.

It is well proved, at least, that the present subterranean brook is contiguous to its ancient course at three different points, that is, at the back, at the center ("Ladies' Cushion") and at the entrance ("Beck Head").

Upon coming out of Ingleborough Cave, it is necessary to redescend to Clapham, to cross the source of Beck Head, to ascend the valley of Clapdale woods, and reach the ravine of Trow Gill. This is a rocky defile of the most picturesque character, that would cut a very good figure among the battlements of the Causse Mejean or of the Dolomitic Alps. It was assuredly the bed (now dried up) of an ancient open air brook. At the very head of the ravine its channel remains, scooped out of the Clapham Bottoms, where are still seen several pot holes encumbered with rocks and thickets, and through which rain alone can pass. After a travel of a mile and a quarter and an ascent of but 490 feet, we reach the largest of all these pot holes, the "Gaping Ghyll," at an altitude of about 1,345 feet. This is not obstructed. It is regular, over 30 feet in depth, and opens on the north side by a natural trench through which a brook flows and falls from stratum to stratum, as if over the steps of a gigantic stairway. This is the Fell Beck, which, collecting the water of about a thousand acres of peat bogs upon the southeast side of Ingleborough Hill, is now entirely swallowed up by Gaping Ghyll. It is evident that of old it proceeded beyond the obstacle, either because the latter was not yet open or because the water of the brook was sufficiently abundant to flow freely outside, through the gorge of Trow Gill.

At the bottom of the well, at an altitude of about 1,300 feet, a hole from 25 to 30 by 12 to 15 feet yawns worthily of its name (Gaping Ghyll). It is as black and vertical as the most perfect abyss of the Causses, and is very dangerous of access, since no wall surrounds it and the well is full of grass made slippery by the aqueous vapor. Fell Beck, abruptly converted into a mysterious subterranean cascade, it swallows down at one draught. It must be this that reappears at Beck Head (at 5,400 feet in a bee line), after allowing a glimpse of itself to be had at the foot of Giant's Hall, at a distance of 4,000 feet.

A difficult sounding showed Mr. Hughes that the total depth was 360 feet below the plateau of peat. This measurement is accurate, as we shall presently see.

About fifty years ago a descent of Gaping Ghyll was attempted by Mr. J. Birkbeck, a member of the Alpine Club. The volume of water and the parting of a strand of his rope, cut by a rock, put him in serious danger and forced him to halt upon a shelf at a depth of less than 700 feet. At a depth of 80 feet below the surface he encountered a subterranean affluent gushing obliquely from a lateral fissure.

On the first of August, 1895, I succeeded in reaching the bottom of the abyss, which according to my sounding, exactly conformable to that of Mr. Hughes, is really situated at a depth of 360 feet beneath the level of the peat, and 328 from the bottom of the well hole. I owed this success to my rope ladders and telephone, and especially to the obligingness of Mr. J. Farrer, the owner of Ingleborough Hall, who had the extreme kindness to have a ditch a mile long dug in order to divert the greater portion of Fell Beck, so as to aid my enterprise. Without such unexpected co-operation the latter would have failed. On account of the rains of the month of July, the brook was considerably swollen, inundations had occurred throughout the district, and even on the first of August the work of diverting the water had not succeeded in deflecting the whole of the current from the abyss. However, what remained was merely troublesome and annoying and presented no other real danger than that of causing the fall of stones.

I must confess that this descent of 328 feet, occupying twenty-three minutes, under a shower bath having a discharge equal to that of a small cascade, was really very disagreeable (Fig. 1). No impermeable garment was capable of protecting me against the complete penetration of the water, which lashed my face severely, even in the last third of the descent. The most inconvenient thing for me was the soaking that my telephone apparatus got, and the operation of which was thus somewhat interfered with. My orders for the maneuvers reached the surface well enough, but I did not catch the answers in my receiver full of water. I desire to state that, in the absence of any person accustomed to my methods of descent, it was my wife who, posted at the brink of the yawning abyss, had to take charge of the telephone correspondence with me during the expedition. Finally, everything proceeded without accident, if not without incident. The telephone cable, having caught in a rock fissure, broke while I was effecting my ascent (which took twenty minutes), but I was already half way up and within range of voices above. None of the stones detached from the projections of the rock by the motion of the ropes struck me. On two occasions, an unlucky knot, by arresting the hauling, left me for several minutes immovable upon the ladder in the strongest part of the cold shower bath. I do not care to dwell here upon the details of this curious and exciting excursion. Without the cascade and with my usual companions, it would have been extremely easy. Except for the last hundred feet, the ladder rested snugly against the wall. Further, I saw clearly as far as to the bottom, and this was a matter of importance, since I did not know very well what light would be able to withstand the impact of the columns of water and air that whirl about in the abyss.

Gaping Ghyll is an abyss due to erosion—a diaclase widened by water (Fig. 2) like the majority of the great avens of the Causses, but differs from the latter in not being finished and not out of service. It is ever in operation as far as its role of absorption well is concerned, and it is one of the best of arguments for the theory of the formation of pot holes. From this view point, moreover, it has many rivals in the neighborhood.

The fissure whence Mr. Birkbeck saw an affluent gush at a depth of 260 feet is simply the outlet of a secondary lateral well which Prof. Hughes recognized in 1872 at a few yards above the principal hole. Owing to the work ordered by Mr. Farrer, this affluent was not flowing on the day of my descent and did not impede me as it did Mr. Birkbeck. The shelf of rock upon which the latter halted is situated at a depth of about 180 feet. It is rather a terrace (or what is called a "redan" in the abysses of France), 13 feet in length by 6½ in width. The sections given in Fig. 3 serve to show the interest that it offers as regards the history of the abyss. Here, in fact, we find the greatest width, because at this point are concentrated the mechanical efforts of the principal waterfall as well as of the affluent springing from the fissure observed by Prof. Hughes.

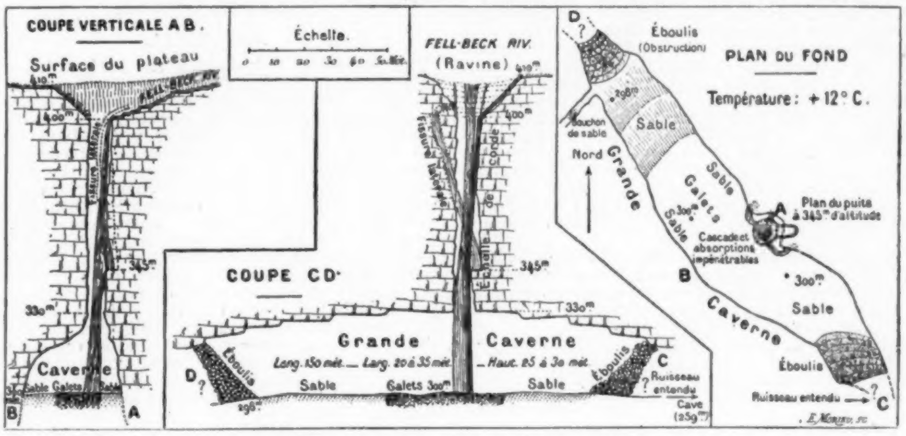


FIG. 3.—SECTION AND PLAN OF GAPING GHYLL.

Vertical section, A B. Section C D, showing the ravine and the large cavern. Plan of the bottom of the abyss, with indications of the nature of the floor.

Now it is very curious to remark that the affluent, not always flowing and being doubtless less abundant than the other large arm, has not, up to the present, finished the deepening of that part of the well which it happens to strike. The narrowing of the abyss below the terrace is due to the fact that, as a consequence of the curve of the two cascades, the stronger does not (except at the time of freshets) ordinarily fall upon the terrace. In fact, I was able to get a footing thereon and take shelter from the cascade. It is the second fall, which is assuredly intermittent, that has especially contributed, through its obliquity, toward thus widening the median portion of the abyss. But there still remain 50 ft. thickness of rock strata for it to remove before the terrace shall disappear, and the well shall be regularly conical down to the large hall that terminates it.

At 230 feet beneath the orifice of the abyss, the ladder suddenly ceased to rest against the rocky wall and swung both in the water of the cascade and the void of an immense cavern. After 100 feet of this pendular descent, always so tiresome and here particularly troublesome under the accelerated fall of the brook, I obtained a footing upon an even floor formed of black sand and round pebbles like those of Ingleborough Cave.

As shown in the plan in Fig. 3, Gaping Ghyll, therefore, ends in a grand nave 490 feet in length, from 65 to 115 in width, and from 80 to 98 in height. It might accommodate a cathedral, whose spire would fit in

FIG. 1.—THE ABYSS OF GAPING GHYLL—DESCENT OF THE FIRST WELL.

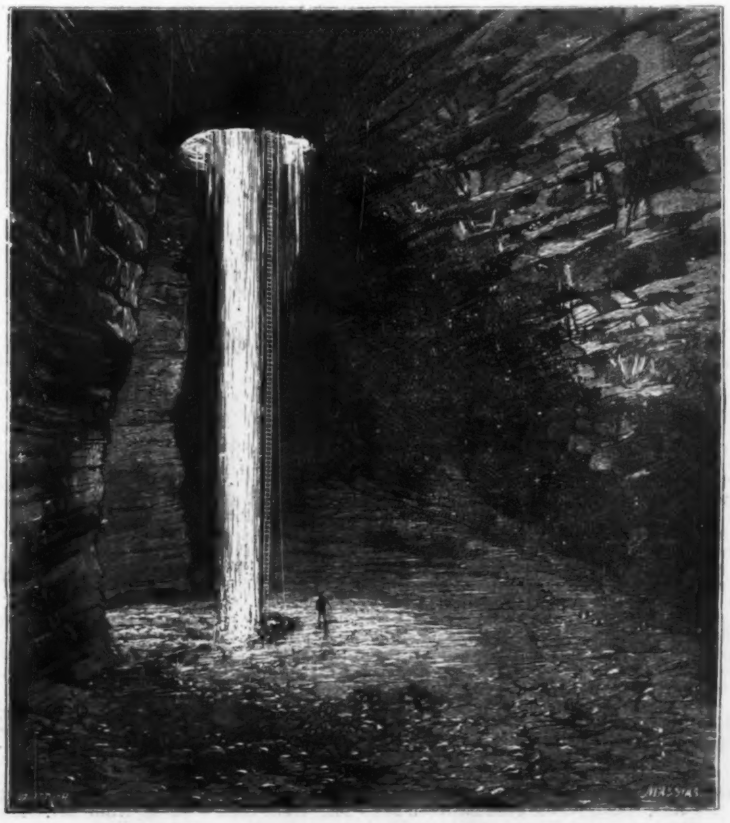


FIG. 2.—THE ABYSS OF GAPING GHYLL—AFTER PASSING THROUGH THE WELL.

the well. The latter may be assimilated to the steam pipe of a colossal boiler in which the role is reversed, the pipe in this case leading cold water to the receptacle instead of carrying hot steam away from it.

There is not a single concretion under the gigantic dome, and there cannot be any, since the chamber must often be full of water. Yet three things here produced as strong an impression upon me as did the depths of Rabanel and Jean Nouveau: First, the almost absolute horizontality of the vault and especially of the floor—that subterranean "shore" of sand and pebbles of 43,000 square feet area, whereon popular imagination, in past poetic times, would not have failed to place a Niebelungen palace. There certainly exists some cavernous voids of greater dimensions, such as Adelsberg, Han-sur-Lesse, Dogilan, Gradisnica, Mammoth Cave, etc., but none, I believe, offers such a regularity. All have a more or less irregular floor, while that of Gaping Ghyll seems to be all ready for waltzing upon. Second, the harmonious murmur and the transparent lightness of the veil of water that falls from above, as lovely as those Alpine cascades that a breeze scatters over the rocks like diamond in powder. Here not a breath of air breaks the mathematical descent, and the oval column of liquid seems to be a moving stalagmite, too rapidly formed to congeal. Third, the feeble daylight that filters into the water, ineffably decomponnded by the millions of prisms of its droplets, and recalling in nothing the lights that are known to human eyes.

It is one of the most extraordinary subterranean sights that it has ever been given me to contemplate.

At a distance of about 60 feet from the cascade, however, one ceases to see clearly, and it was by means of numerous candles arranged all around the chamber that I had to make a very hasty plan of it (in an hour and a quarter only).

It is by constant action that the water has excavated the grotto by corrosion as well as by erosion. The fissuration, the multiplicity and the horizontality of these strata of carboniferous limestone have singularly facilitated the work.

But I am unable to say whether this great cavern is simply an expansion of the abyss that surmounts it or whether it represents an enlarged portion of an ancient subterranean river passing directly under the abyss.

In fact, at each extremity, a steep slope of fallen rubbish closes the chamber—rubbish detached from the vault in large angular fragments, neither rolled nor rounded by water, thus proving that they are of relatively recent age. This debris from the strata of the vault entirely bars the passage. It would be necessary to clear it away in order to seek the prolongations of the cave.

Having descended all alone, I was unable to think of such a thing as undertaking this work. But in climbing the southwest side, which is in the direction of Ingleborough Cave, I distinctly heard the noise of a brook through the interstices of the blocks. It is very certain that the escape of the freshet waters is effected on this side. At the foot of the southeast slope, I found the cover of a tin fruit can that had fallen from above and was light enough to have been carried along by the current to the slope. No other object, neither bones nor dead wood, was visible. The gravels and pebbles of the Fell Beck bury everything.

According to the prediction made by Prof. Hughes (On Caves), the water of the open air stream has here no outlet practicable to man. It filters in several places through the sand and pebbles of the bottom. The conduits that lead it toward Giant's Hall will not be discovered until the southeast extremity is cleared of obstructions.

At the northwest angle, likewise, there is a small and quite high gallery, about thirty feet in length by three in width, which would, perhaps, be found to lead to other passages or chambers were the sand that closes it removed.

What is the depth of the alluvial deposit? What animal remains does it contain? At what depth lies the original floor covered by gravel? This is something that nothing but a bore hole will be able to teach us.

I am simply able to say that on the 1st of August, 1895, the altitude of these gravels was 1,000 feet above the level of the sea, say 158 feet higher than the source of Beck Head, that the water of the fall, before infiltering, marked 12° C., and that the cavern was very damp.

The difference of level up to the river that flows back of Giant's Hall must be about 130 feet. For 3,960 feet in a bee line, this gives a gradient of 3·28 to 100. Now the grotto of Saint Marcel, of Ardeche, has a gradient of but 4 to 100. It is therefore probable that back of Gaping Ghyll, at Giant's Hall, there exist, at least in places, waterfalls and important accidents. Would these be accessible were the slopes cleared away, or would they rather be protected against man's curiosity by siphons or passages that are too low, like those of Giant's Hall? This is something that future explorations will tell us.

Twice already since my descent, Messrs. Calvert, Booth, Gray, Green and others, of Leeds, have endeavored to repeat it. Upon each occasion bad weather and the abundance of the water arrested them as they did Mr. Birkbeck. Mr. Calvert was able to proceed no further than 230 feet.

It is to be hoped that they will not allow themselves to be discouraged by such want of success. As may be seen from what precedes, Gaping Ghyll is an abyss of the greatest interest, and we should not perhaps despair of some day seeing its direct communication with Ingleborough Cave established.—E. A. Martel, in La Nature.

ABYSSINIA.

THE process of subjugating the various tribes and nationalities of the Dark Continent to European control is not confined to the southern half of Africa, although recent events have directed the attention of the outside world most closely to the land of gold and diamonds. Italy is engaged in a struggle with the people that dwell to the westward of the Red Sea, which is practically a war of conquest, though the continued Italian reverses, culminating in their terrible defeat at Adowa, make it extremely doubtful if the war will end in practical possession. This is not the first time that the swarthy Abyssinian has fought against European troops. In 1868 an English army was dispatched to the rescue of two subjects of the Queen, who had been imprisoned by the Emperor Theodore. They landed at Mulkutto, on Annesly Bay, and the pioneers of the English expedition in their journey of 400 miles into the interior "followed to some extent the footsteps of the adventurous soldiers of Ptolemy, and met with a few traces of the old world enterprise."

This expedition was the means of directing attention to a little known, though very ancient kingdom; indeed, Abyssinia is one of the most ancient monarchies in the world, and from time immemorial it has been under the government of an emperor.

In its natural features the country presents a series of lofty table lands, intersected by a succession of mountain ranges and intervening valleys. These mountains which reach an altitude of 12,000 to 13,000 feet above the sea form the watershed between two systems of drainage; one of which flows easterly to the Red Sea and the other, and larger, in a general northwesterly direction to the valley of the Nile. Abyssinia is said to enjoy "probably as salubrious a climate as any country on the face of the globe." There is a cold, a hot, and a rainy season; the cold season lasting from October to February, the hot from March to June, and the wet or monsoon period from June to September. Markham, speaking of the natural features of the northern portion of the country, says: "The general appearance of the plateau and plains is that of a comparatively bare country, with trees and bushes thinly scattered over it, and clumps and groves only occurring round villages and churches. But the glens and ravines in the plateau sides are often thickly wooded, and offer a delicious contrast to the opening country." In the south the fertility is so great that as many as three crops are frequently raised annually. Maize, wheat, barley, peas, beans, etc., are grown in large quantities. A considerable amount of cotton is also grown. Most of the domestic animals known to us are to be found in Abyssinia.

The Abyssinian race is a mixed one, the Caucasian element predominating. The prevailing religion is "a corrupted form of Christianity. They are a rude and semi-barbarous people; much given up to war; and life is held in light estimation." The above mentioned Mr. Markham, as the result of his experience, states that he is of the opinion that "the Abyssinians are capable of civilization Their agriculture is good, their manufactures are not to be despised, but the combined effects of isolation, the inroads of predatory tribes, and internal anarchy, have thrown them back for centuries."

The northern portion of Abyssinia originally formed part of the ancient kingdom of Abyssinia; and the Abyssinians claim that the Queen of Sheba, who is mentioned in the Bible as visiting Solomon, was Queen of Abyssinia, and that the subsequent line of kings trace their descent from her. Historically, this little known country is full of interest; it is capable of great agricultural development; and the restless activity of its races, if it can be brought under the control of civilization, may result in a future material development of the nation. Italy has undertaken the task. Thus far she has made but little progress; and now comes the news that the Abyssinians have inflicted a crushing defeat upon General Baratieri and his invading army. The battle took place among the mountains, and in a country so broken as to prohibit the maneuvering of the Italian troops. All the guns, and a vast amount of ammunition and stores, fell into the hands of the victors. The first reports stated that 500 Italians had perished, and this has been swelled to 2,000 and again to a total of 5,000 slain. This calamity has produced a profound sensation, not only in Italy, but among the diplomatic circles of Europe.

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